JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

APRIL, 1835.

Address upon a proposed Rail-road from Wilmington to the Susquehanna, together with a Report of the Survey made by William Strickland, Esq., Architect and Engineer.

(WITH A MAP.)

The route through Wilmington, Elkton, North East, and Charlestown, to the Susquehanna river, has been, from the earliest settlement of the country, an established route in the great chain of communication running through Philadelphia and Baltimore. It is the shortest road between these two cities, and, until the establishment of the steamboat and rail-road line through Newcastle and Frenchtown, was the most expeditious, and, as such, was the regular route for the transportation of the United States Mail. In the winter season, when navigation ceases, it is still the line by which that mail travels. The peculiar advantages which this route possesses over all others, points it out as the natural thoroughfare over the peninsula, available at all seasons of the year, the shortest, and, when the proper artificial means are applied, the most expeditious. Convinced of these facts, the attention of intelligent individuals in Wilmington has for many years been directed to the subject of a rail-road communication along this route, as one which would at once unite great public convenience and utility, with a profitable investment of capital. An act of incorporation was obtained from the legislature of Delaware, in the year 1832, authorising a company, with a competent capital, to construct a rail-road from Wilmington to the line of the state of

Maryland, in the direction of the Susquehanna; and in the same year, a similar act was granted by the legislature of Maryland, providing for a continuation of the road through that state; and, by provisions in their respective charters, the two companies are authorized, after their capital shall be subscribed, to unite their stocks, and form one company. The capital authorized to be created in each state, is $400,000. The charters in both states are perpetual. Circumstances which it is unnecessary to detail, have delayed the serious prosecution of this undertaking until within a few weeks past. In the beginning of January, a committee, appointed by a town meeting of the citizens of Wilmington, employed William Strickland, Esq., of Philadelphia, to make a survey of the route from Wilmington to the bay of North East, who, having performed that duty, has submitted a report, which realizes all our anticipations of the facility and moderate expense with which an easy and excellent rail-road, shorter than the post road, may be constructed. Of this survey, as it is intended that Mr. Strickland's report shall accompany this, all the circumstances are so fully explained in it, that the committee will here simply refer to it, and pass on to a brief explanation of the advantages of this undertaking, and the inducements it presents as a profitable investment of capital.

The peculiar advantages belonging to a rail-road by this route, are: First—Its shortness. Second—Its capacity for constant use at all seasons of the year. Third—Its connection with the river Susquehanna. Fourth—The character of the country through which it passes.

And 1st—*Its shortness.*—The whole distance from Philadelphia, through Wilmington and Elkton, to Charlestown, at the head of the bay of North East, is one mile less than the distance to Frenchtown, by the way of the river Delaware and Newcastle. From Charlestown it is but five miles to the Susquehanna ferry, opposite to Havre-de-Grace, and thence thirty-six miles to Baltimore. As a mixed steamboat and rail-road route, the distance from Philadelphia, through Wilmington, to Charlestown, is but three miles greater than the distance through Newcastle to Frenchtown; and the distance from Frenchtown to Baltimore is fifty-six miles, while from Charlestown to Baltimore it is but fifty miles, making a difference of six miles in favour of this route, in the whole distance. Thus much for the actual distance. In point of time, the advantages of this route consist in nearly ten miles more of rail-road travel, of an excellent landing at Charlestown, and an open navigation, entering at once into the bay, without obstructions of any kind. In point of shortness, then, both of distance and time, the committee express a confident opinion that there is no route between the two cities which will compare with this.

2d—*Its capacity for constant use in all seasons of the year.*—Although the present survey has stopped at the bay of North East, the acts of incorporation contemplate an extension of the road to the Susquehanna, and the company, when organized, will undoubtedly deem it their interest to carry into effect the intention of the law.

The termination of the road, according to the present survey, at Charlestown, will be but five miles from the Susquehanna ferry, opposite to Havre-de-Grace, and is in the direct line to it. It has been ascertained that the extension of the rail-road to that point is practicable and easy. In view of these facts, it is obvious that, during the obstruction of the navigation in the winter season, this route must of necessity be the thoroughfare across the peninsula, available in all weather, and from that circumstance, securing the transportation of the mail, and the carriage of passengers. As connected with this view of the subject, it may be proper to add, that there is a law of Maryland authorizing the construction of a rail-road from Baltimore to Havre-de Grace, which has been already surveyed, and that there is at this time an excellent turnpike road from Baltimore to Bush, about eleven miles from Havre and Port Deposite.

3d—*Its connection with the river Susquehanna.*—The probability, indeed, we may say, the ultimate certainty, of such a connection, has been adverted to in the preceding paragraph. Such a connection, by opening an avenue for the transportation of the vast produce of the Susquehanna on this road, presents advantages too obvious to render any illustration necessary.

4th—*The character of the country through which it passes.*—The route is laid through a populous and well cultivated district, and one which is probably not surpassed by any other of the same extent in the union, in the number of mill seats abundantly supplied with water. A great deal of this mill power is now applied to various and valuable manufactures of cotton, wool, iron, and flour, and the introduction of so ready an access to a market as the rail-road will present, cannot fail to bring into requisition and use, a great amount of manufacturing power, that is now unemployed.

Wilmington itself is situated in the midst of a great manufacturing district, embracing almost every species of valuable manufactures in our country. The vast manufactures of the Brandywine, in powder, flour, cotton, wool, and paper, will furnish a large amount of transportation for the road. Two large and valuable steamboats are owned in the place, and have for several years carried on a profitable business, in passages and freights. They would at once constitute a good beginning of a steamboat line, being already engaged in a regular and profitable business.

These advantages the committee present as peculiar to this route, of which it cannot be dispossessed or deprived by any competition. Adverting to others of a general character, in which a fair competition is to be encountered, they cannot see the slightest reason to doubt its ability to sustain itself. As an important connecting link in the great chain of artificial communications, passing from New York, through New Jersey and Pennsylvania, and through Maryland to the river Ohio, it cannot but obtain a fair proportion of the immense and increasing mass of travellers who are constantly passing north and south, on these great thoroughfares. The number of passengers over the Newcastle and Frenchtown rail-road, within the ast year, is said to have been 100,000; and the rate of increase is

estimated at ten or twelve per cent. annually. The rapid increase of population in our country, combined with the rapidly increasing facilities of communication, give abundant assurance that this increase will steadily progress. From what has been previously stated in this address, we deem it fair to say, that the Wilmington and Susquehanna Rail-road may justly claim a moiety of this vast amount of business—a proportion which, with the exclusive sources of business and profit already adverted to, will, it is believed, amply repay the investment.

The committee conclude by referring to the report of Mr. Strickland, which is appended, for details relative to the practicability, length, and expense of constructing the road, and for other particulars connected therewith.

Wilmington, Feb. 17, 1835.

JAMES CANBY,
JOHN WALES,
W. B. BROBSON,
DAVID C. WILSON,
H. WHITELY,
JAMES SEWALL,
T. S. THOMAS,
} Committee.

Philadelphia, Feb. 11, 1835.

SIR,—I have the honour to transmit to you my report and estimate of the cost of constructing a rail-road from the city of Wilmington to the bay of North East.

These documents are accompanied with a map and section, exhibiting the route and grade of the road, together with the principal streams, common roads, and towns, which lie in, and are adjacent to, the track.

There are twelve printed copies of the report, one for each member of the Committee of Survey; no more will be printed, unless so ordered by you; and when the lithographic map is finished, it is intended that it should accompany the report, as a means of more comprehensive illustration.

In the specification and estimate, you will perceive that I have comprehended all the items necessary to make a perfect and substantial road, including store-houses, wharves, and fencing in of the whole line; in short, every thing, except locomotives and car machinery.

As soon as the navigation opens, it is my intention to send to the Committee of Survey a specimen of the kind of edge* rail which is

* This rail was invented some years ago, by Samuel V. Merrick, Esq., of Philadelphia, and was favourably reported on by the Committee on Inventions, of the Franklin Institute. The first rails of this form were rolled in England, from drawings made by him. The annexed cut exhibits a transverse section of the rail; it evidently combines greater stability and strength, with less weight of material, than any other edge-rail yet devised.

COM. PUB.

embraced in the estimate. It is of the most simple character, combining substance and strength, where these properties are most requisite. I hope the committee will not make a choice of wooden string pieces, merely on account of the difference in the cost, which is of no importance, compared with the permanence and lasting properties of the *iron edge rail;* particularly so, when we consider that the road is to be so great a thoroughfare for light and rapid transit, as well as for heavy trains of burthen cars.

The estimate is made with great care, and will cover every thing in a substantial and workmanlike manner; such as it ought to be, both for economy, as well as permanency and duration; at least, it is such as I will not hesitate to contract for and completely finish in all its parts.

With great respect, &c.

WILLIAM STRICKLAND.

To JOSHUA GILPIN, Esq.,
Chairman of Comm. of Superintendence,
Kentmere, Brandywine, Delaware.

REPORT.

Wilmington and Susquehanna Rail-road.

TO THE COMMITTEE OF SURVEY.

GENTLEMEN,—Your instructions of the eighth of January last, requiring the survey of a route for a rail-road between the city of Wilmington and the bay of North East, have been complied with, and I have now the honour to report to you a map of the country, containing the course and sectional grade for a rail-road between these two points.

Having had the advantage of an early acquaintance with the topography of this district of country, between the bays of the Delaware and Chesapeake, it was not in the least difficult for me, in the commencement of the exploration, to determine the general course, that would at once combine straightness with the least irregularity of surface; with a single view, therefore, to these characteristics of a good route for a rail-road, I have succeeded, I think, in tracing a line combining the lowest grade with the shortest direction.

It has been suggested that a more direct and eligible route might be obtained for a rail-road on the southern banks of the Christiana creek, by crossing this stream at Wilmington, and pursuing a course to the south of Iron hill, to a point near Elk landing, and from thence to North East, by the valley of Mill creek.

There is not, perhaps, in any other district of the union, an equal area of country embracing so many mill seats, with a bountiful supply of water, as that portion of Newcastle county which is contained within the quadrant circle of the twelve miles radius. Agricultural products, and manufactures of various kinds, abound on the tributaries which flow in upon the northern banks of the Christiana; and the

route for a rail-road, as laid down on this side of the stream, passes through a populous country, where mill power is applied to a great extent, and where the means of communication with a market like the route under view, will always command a great accession of freight and passengers. But few of these advantages exist on the southern side of the creek, and a single glance at the accompanying map will show that nothing, in point of distance, can be gained by this proposed route.

First Division.—On leaving Wilmington, it is necessary, in order to avoid the marshes on the northern side of the creek, to pursue a line of great curvature along the margin of the fast land, to a point below Moody's. At Moody's, there is no difficulty in making a choice between a level bottom and upland, where the line is laid in nearly a straight direction to Newport and Stanton. The surface of the country back of these town is entirely too high and undulating to pass out from the valley of the Christiana. Stanton lies nearly in the straight line from Wilmington to Elkton, and Newport is a little south of this line. A surface of ground of great uniformity, and upon a dead level, is obtained by the way of Latimer's woods, and the foot of Indian hill, through the town of Newport, Wardell's, and *Bread and Cheese* Island, to the Red Clay, at Stanton. This division of the route is five and a half miles in length, and can be laid at a small expense.

Second Division.—At the crossing of the Red Clay, near Bailey's mill, the banks of the opposite shores of this stream approach within 150 feet of each other, where a bridge of 75 feet span can be easily and cheaply constructed. From Stanton, Ogle-town is to the south of the same straight line to Elkton, and the route traced, passes through the bottom land of White Clay creek, on the north side of the stream; it crosses Mill creek near the barn of Dr. Reynolds, and proceeding through Francis and James Denny's land, it passes the White Clay at Morrison's, near Price's mill, from whence it continues in nearly a direct course, rising at a grade of about twenty feet to the mile, to the north bank of Ogle's run, near the bark mill, which is but a short distance from Ogle-town, on the road to Newark. This division of the route is four and a half miles in length, three of which is nearly level, and exceedingly easy of execution. Mill creek will require a bridge of seventy-five feet span, with embanked approaches of moderate length, and about twenty-five feet in height. The White Clay bridge must consist of five spans, of seventy-five feet each, with short embanked approaches of twenty feet in height.

Third Division.—On leaving the bark mill near Ogle-town, the same direct line heretofore mentioned as our guide to Elkton, passes between Iron and Chestnut hills, near Tyson's mill and ford; these hills are directly in the route to Elkton, and are connected together by a link or ridge of land, entirely too high for the passage of the rail-road. To pass round Iron hill to the southward, would require a great degree of aberration and curvature from the direct course, and, consequently, an increase of distance; the nearest approach,

then, to the straight line from the bark mill, onward, is by the northern foot of Chesnut hill, to the ravine of Persimmon run, at its junction with the head of the Christiana creek, below the forks. This division of the route is three and a half miles in length, upon an ascending and easy grade of about twenty feet to the mile. It will require but small bridges to pass Ogle's run, and the Christiana creek.

Fourth Division.—Pursuing the ravine of the Persimmon, which skirts the northern slope of Chesnut hill, the route crosses at the tangent point, or commencement of the circular line between the states of Delaware and Maryland, and rises by an easy grade to the level of the table land near the road leading from Newark to Elkton. It passes the summit about half a mile to the eastward of the old canal feeder, and gradually descends, at the grade of twenty-five feet to the mile, into the valley of Cow run, near the foot of Bell hill, at Ricketts', and crosses the Big Elk below Gilpin's ford, in nearly a straight course towards the Little Elk. Here the line leaves the town of Elkton about three quarters of a mile to the southward, where a branch line may be made to curve into the town upon a dead level. The fourth division extends to the Little Elk at Crawford's mill, and is six miles in length; it passes the summit about midway between the Persimmon and Elk, and upon very even and favourable ground. The passage of this stream will require a bridge of five spans, each seventy-five feet in length, with an embanked approach on the eastern side of the creek, of 800 feet, by twenty feet in height. The Elk is wild and impetuous; it runs through extensive flats, which are subject to overflow, and great care must be taken to promote a free passage for the water. The Little Elk is also of the same character, but a much smaller stream. Two spans of seventy feet, with short embankments, eighteen feet in height, will be sufficient at this pass. The ground upon which the line is laid, between these streams, is exceedingly favourable, and forms a level esplanade for the whole distance to the north and west of the town of Elkton.

Fifth Division.—After crossing the Little Elk on the south of the post road, the line curves towards Mill creek valley, and there it is laid in nearly a straight line through the barrens of this stream, for the distance of three miles, upon a rising grade of thirty feet to the mile. The ground to the right and left of this portion of the line, as far up the valley as M'Vay's, is very rough and undulating, and gives us no choice but to pursue the course of the stream. The numerous small runs of water which come in from the ridges on both sides of the line, must be led off by wide ditches and drains. M'Vay's is situated at the foot of the eastern slope of Bacon hill, where the ridge, or highest point of land, divides the waters of the North East river and the Little Elk. At this place, the valley of Mill creek continues in nearly a straight course, and rises rapidly to the summit of Bacon hill. From a distant view of this hill, it would seem to

afford a low pass in a direct line to the town of North East; but from a trial line of level, it proved to be entirely impracticable, being nearly 170 feet above the tide, and but two miles distant from the contemplated western termination of the road, on the river, at Simper's point. However desirable an object it might be to keep up, for this short distance, the existing straight and uniform direction of the route from Wilmington to the river at North East, I regret that it could not be effected but by resorting to a long deep cut, or tunnel, and the necessity of inclined planes on the western descent to the river. A resort to fixed machinery of any kind, on a public line of road, is highly objectionable, as it creates a never-failing source of expense, delay, and danger.

By curving the route to the northward, at a point in the line below M'Vay's, Bacon hill may be avoided altogether, and a pass through a sandy ridge can be had, by an average amount of cutting to the depth of twenty-two feet, for a distance of about 1800 feet in length. After passing this ridge, which is found to be about thirty feet lower than that at Bacon hill, a reversed curve of large radius will lead the line into a straight course toward the town of Charlestown, by crossing the North East river at a point between the forge and the town. This inclination to the northward will be highly favourable to the ultimate continuance of the route toward the ferry on the Susquehanna, opposite Havre-de-Grace. Simper's point is one mile below the town of North East, and is situated at the head of the navigation of the bay; the river between this point and the town, is made up of shoal water, and extensive mud flats.

Charlestown is equally as eligible a point for the termination of the rail-road, and is but two miles distant from the crossing of the North East river, on the road to the ferry at the Susquehanna. If the rail-road terminates at Simper's point, it must curve to the southward, and pass through the town of North East, at the distance of one and a half miles from the line direct to Charlestown; and if the termination be at Charlestown, the whole distance will be increased about three quarters of a mile. Both these positions are highly favourable for steamboat navigation, and for the construction of wharves, store-houses, &c. &c. This division is six and a quarter miles in length.

Upon a review of the whole line, it is highly satisfactory to find that it is laid nearly in a straight course, and that the several divisions which have been described, amount in distance to twenty-five and three quarter miles, counting from Market street, in the city of Wilmington, to Simper's point, at the head of the bay of North East. It is shorter than the post road, deducting the unavoidable increase of distance at the points of commencement and termination. One-third of the distance is level, and will require but little expense in execution. In the gradual approach to the table land, or summit, between the White Clay and the Elk, the grade is from fifteen to twenty-five feet in the mile, with but little cutting and embanking.

In passing the ridge between the Little Elk and North East, the ascending and descending grade is from twenty-five to thirty-five feet in the mile. The cutting at this ridge will be but forty-two feet, at its greatest point of elevation, while the shortness of the distance through it, together with the loose character of the soil, will render the excavation easy to execute, and at a moderate expense.

The soil, throughout the whole route, is uniformly composed of light loam, and a mixture of sand and gravel. Stratifications of white and red clay crop out on the summits of the ridges and table land. But few points of rock are touched by the line, and these occur only at Moody's, the crossing of the White Clay at Morrison's, and at the base of Chesnut hill. Detached boulders of horn-blende, hematitic ironstone, chalcedony, and jasper, lie scattered on the surface, and intermixed with the soil. Sand and clay form the whole surface of the country, from Elkton to the bay at Simper's point.

The principal bridges and embankments at the Red Clay, White Clay, and the two Elks, will constitute items of considerable cost in execution; these are unavoidable, and the expenditure ought to be liberally applied toward their substantial construction; particularly so, under the consideration of the smallness of the amount of labour in grading, fixing rails, and forming all other parts of the road, which you will perceive, upon reference to the detailed estimate accompanying this report, does not average more than $19,000 per mile, for the whole distance from Wilmington to North East. The cost of the bridges, both large and small, including the culverts and drains, wharfing, and the fencing in of the whole route, amounts to $169,485, making a total of $507,623, to which is added three per cent., for contingent expenses and supervision.

In this estimate, an edge rail, similar to that used on the Liverpool and Manchester road, is contemplated, which is to be laid on white oak sleepers, and fixed in line, with half chairs on the inner and outer sides of the rails, omitting entirely the stone blocks and wooden string pieces, plated with flat bars of iron.

The whole distance from Philadelphia, by a rail-road route, passing through Wilmington and Elkton, to Charlestown, at the head of the bay of North East, is one mile less than the distance to Frenchtown, by the way of the river Delaware and Newcastle. At Charlestown, it is but six miles to the ferry on the Susquehanna, and five miles from thence to Port Deposite, by the river route; and whether *this route* be regarded as the great mail line, affording a speedy transit alike for passengers and goods to Baltimore, and for the conveyance of the products of the Susquehanna from Port Deposite, it is evidently the shortest and most direct that can be practically and efficiently established.

In conclusion, I must be permitted to express great satisfaction in the verification and close agreement of my present levels, with those which were made twelve years ago, in the survey of the northern route for the Chesapeake and Delaware Canal, a great part of which

route, you will perceive by the map, is now reported to you, as the most favourable ground for the contemplated rail-road.

Respectfully submitted, &c.

WILLIAM STRICKLAND,
Architect and Engineer.

Philadelphia, Feb. 10, 1835.

To Messrs. JOSHUA GILPIN,
THOMAS GILPIN,
JOHN CHEW THOMAS,
JAMES CANBY,
JAMES SEWELL,
DAVID C. WILSON,
WILLIAM CHANDLER,
HENRY D. MILLER,
GEORGE CRAIG,
JOHN EVANS,
} *Committee of Survey.*

NOTES OF AN OBSERVER.

Remarks on Professor Olmsted's Theory of the Meteoric Phenomenon of November 12th, 1833, denominated Shooting Stars, with some Queries towards forming a just Theory. By JAMES P. ESPY.

(Concluded from p. 160.)

In connexion with this subject, I am glad to take the present opportunity of recording, and communicating to the public, the following most remarkable occurrence, communicated to me by Mr. Sears C. Walker, of Philadelphia.

Philadelphia, Dec. 8th, 1834.

DEAR SIR,—I send you enclosed the statements of Mr. Riggs, and Mr. Black, concerning the falling bodies seen on the evening of the 7th, and morning of the 8th, of August, 1833.

I should not have mentioned the occurrence of this phenomenon, but for the extraordinary interest on such subjects, excited by the meteors of November subsequent.

The weather during the day was precisely like that on the 12th of November, viz: rainy in the morning, and clearing up gradually from noon to sunset, but not entirely clear, with wind from westward till eight or nine o'clock in the evening. Going into an eastern room, at half-past eleven, to observe the immersion of m Ceti, I observed a great number of falling bodies in the field of view in the telescope; they cast a slight shade on the moon's disk, in falling, but were only partially opaque. Their appearance reminded me of that of phosphorus, slightly heated, so as to be visible, at night, when near. I thought that they were embers, or like the white ashes from burning pine, when blown suddenly, and listened to know if there was not a

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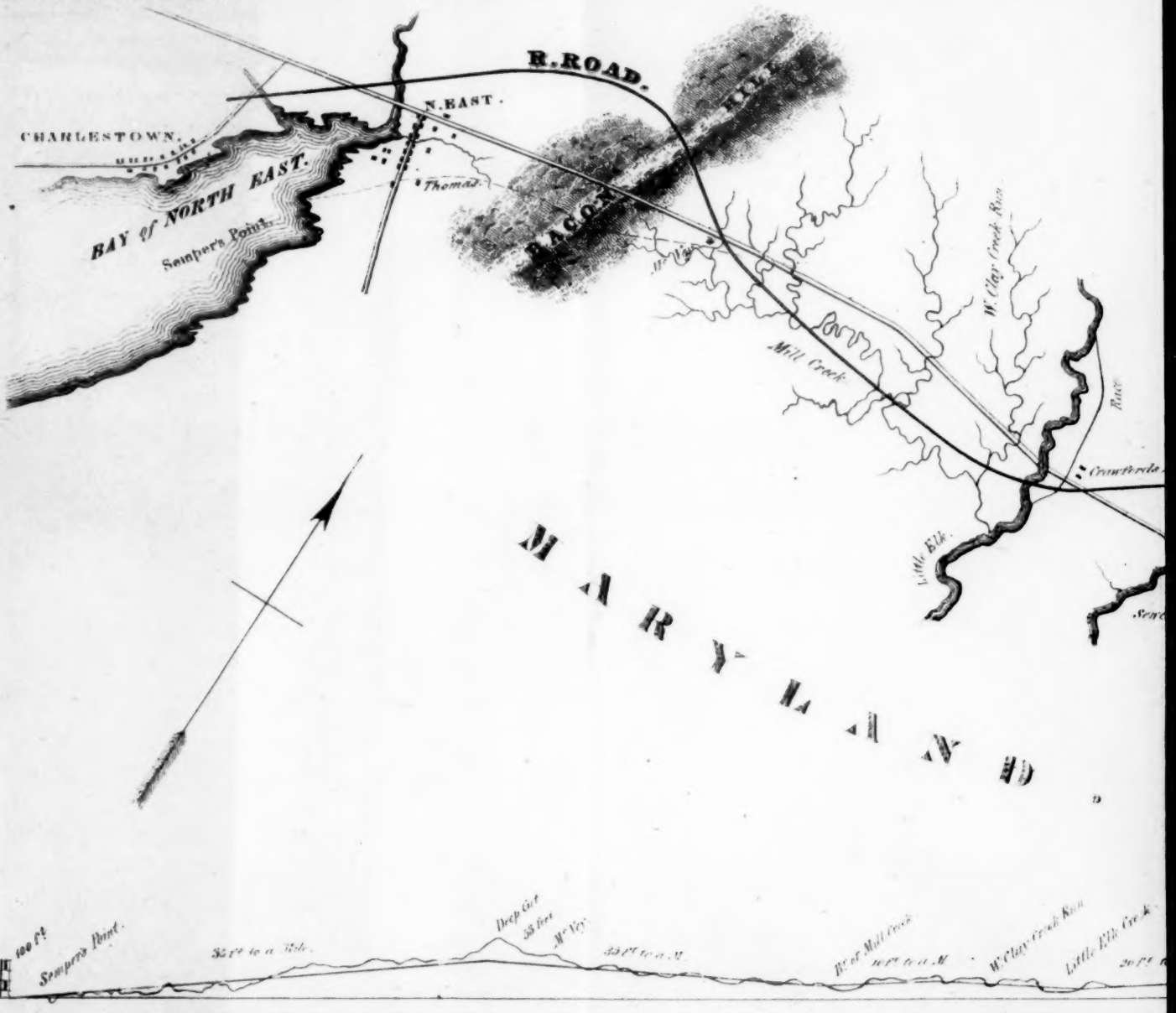
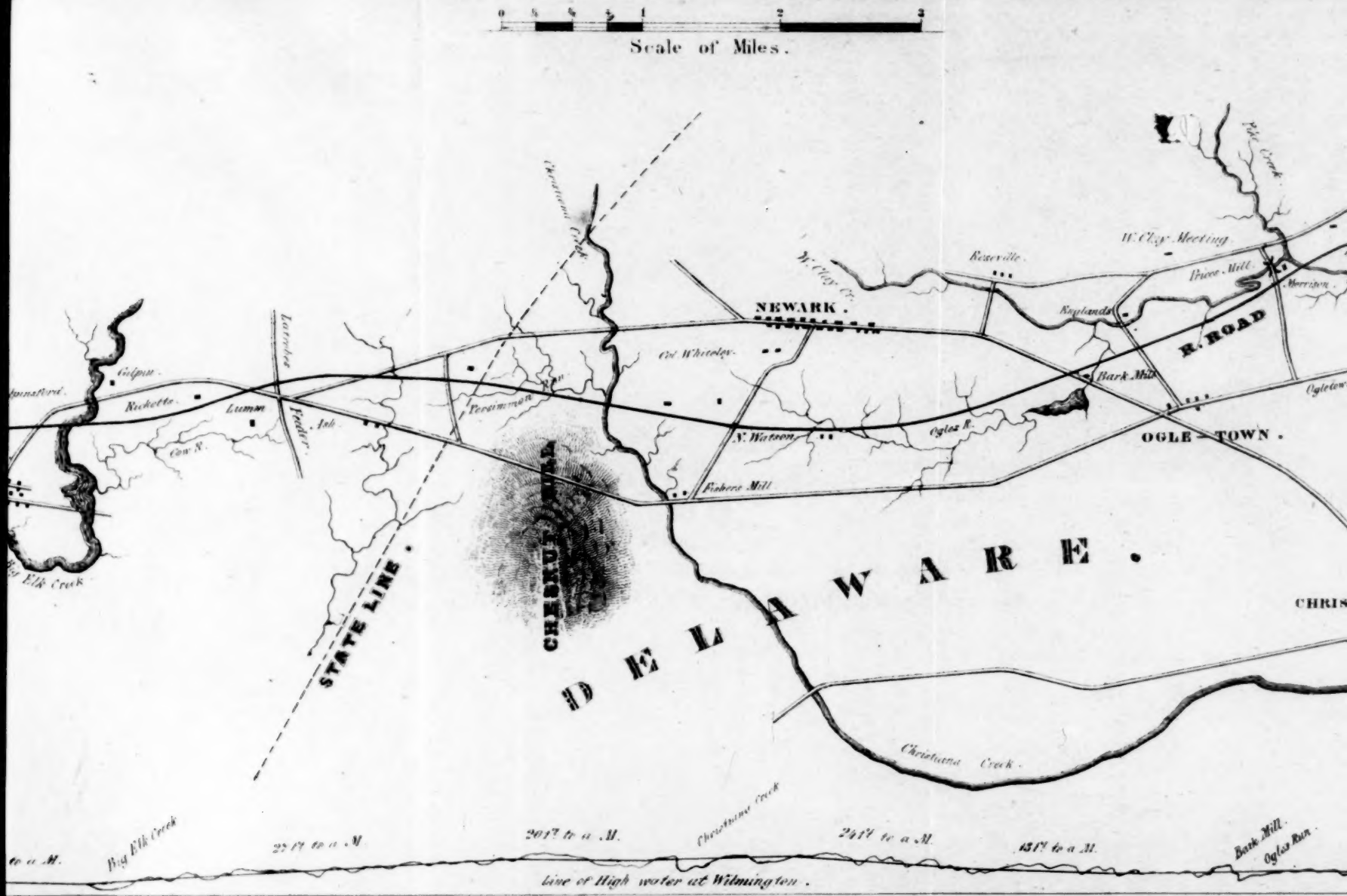
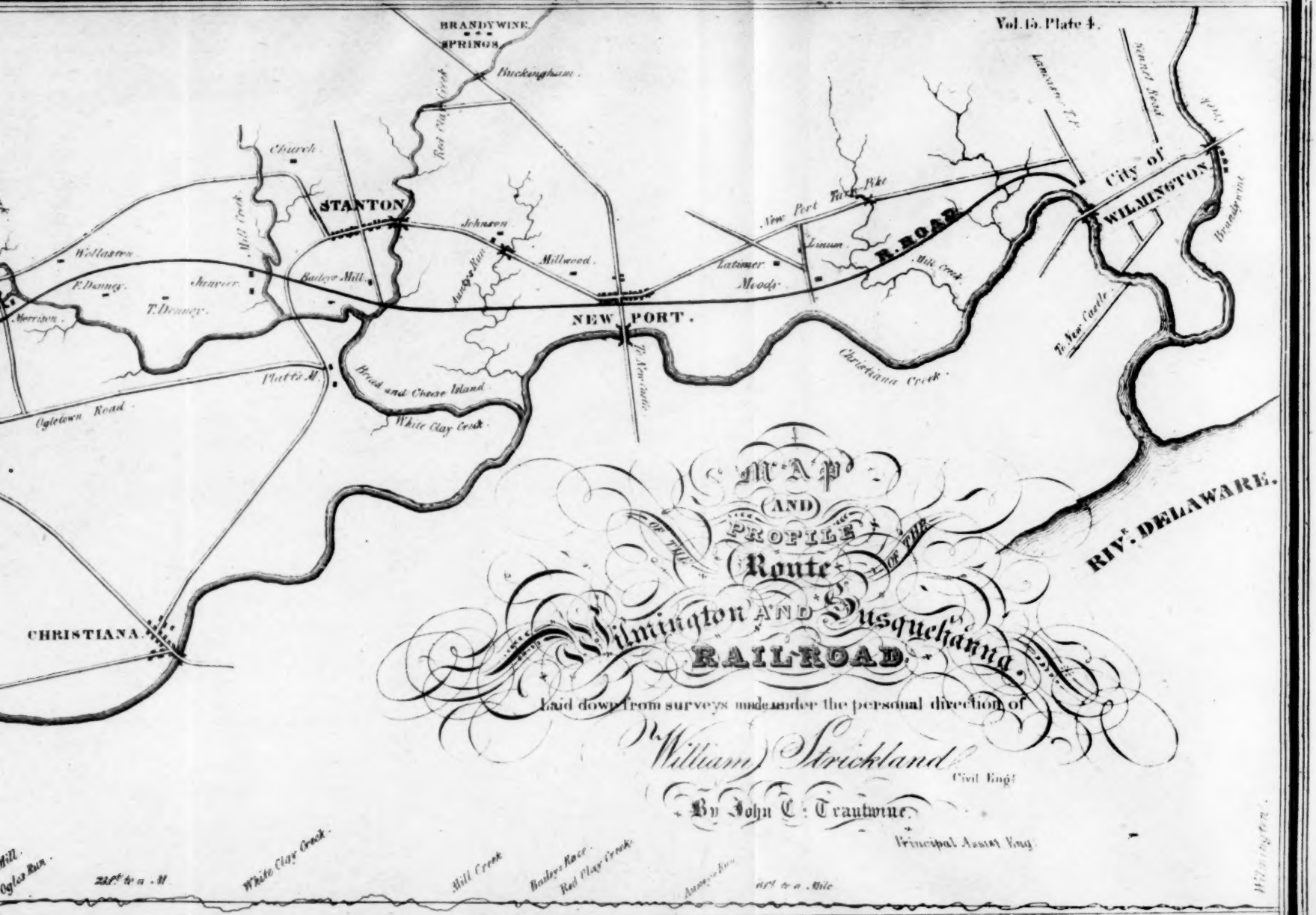


Lehman & Duval Lith.rs No. 67 Dock Street opposite the Exchange Philadelphia.


Scale of Miles.
NEWARK.
R. ROAD
OGLE-TOWN.
STATE LINE.
CHESAPEAKE & DELAWARE
Christiana Creek.
Line of High water at Wilmington.
PROFILE.



On Stone by G. J. Becker.

Jour. Frank. Institute.
CHARLESTOWN.

fire from which they might proceed; but there was no alarm of fire, nor did I hear of any fire that occurred that evening.

I was not aware that they could be seen, except in the telescope, and supposed them at a great distance; and I should have continued of the same opinion, but for the fact that Mr. Black, who is employed to note time for Mr. Riggs, saw them on every side.

I have never seen any thing of the kind, before or since, in a telescope, and can only suggest that, possibly, they were meteors, which would have been more generally noticed, but for the moon's rays, which prevented their being readily seen, or attracting much attention.

I send this statement to you, as Chairman of the Committee on Meteorology.

Very respectfully,

Your ob't serv't,

S. C. Walker.

James P. Espy, Esq.

I was observing the occultation of m Ceti, with a Dolland telescope, three and a half feet achromatic power, about thirty, on the top of house No. 100 South Eighth street. My attention was arrested by falling bodies, resembling snow; but reflecting that it was the warm season, (August,) I was convinced that they could not be snow. They seemed more like burned ashes, and fell mostly in a north-easterly direction. They seemed very light, and fell slowly, like flakes of snow, in a waving manner. I saw them, at occasional intervals, during fifteen minutes. We were unable to note the precise moment of the star's immersion, probably owing to our attention having been attracted by these falling bodies, (whatever they were.) The immersion was, however, noted precisely, to a second, by another person in the same premises, although out of my sight and hearing at that particular moment. We had a conversation on the singular, and, to us, at the time, extraordinary appearance of such things at such a time of night, (12 o'clock, P. M.) as it appears by our memorandum. The star is recollected by its diminutive size, being about the fifth magnitude, and more particularly so by my disappointment in not having noted the precise moment of its reappearance.

The occurrence took place on the 8th of August, 1833, as appears by the recorded observation of the star's immersion, but no note was made in writing by us at the time of the occurrence of the falling bodies, although frequently spoken of.

Wm. H. C. Riggs.

Philadelphia, Dec. 8th, 1834.

My impression was, that they were large flakes of snow, floating very lightly. I saw them plainly without a telescope, on all sides, falling quite thick. Mr. Riggs said there were birds before his glass, shortly after the immersion. I saw them falling near ten minutes;

I did not observe them longer, and do not know whether they continued longer or not.

JOHN BLACK.

By examining my meteorological journal, I find that the dew-point sunk 21° from the 7th to the 9th of August; on the 7th it was 73°, and on the 9th it was 52°, and on the night of the 8th there was a great rain.

Whether these were meteors or not, I will not attempt to say; the phenomenon is certainly worth recording; perhaps it may induce others to publish similar appearances, if any such have occurred. I may mention here, that in almost all cases of a sudden fall of the dew-point, it was succeeded by a fall of the temperature, and this too, *sometimes*, when the wind was coming from some southern point, as on the 31st of March, 1833, mentioned above. I find it difficult to conceive any cause adequate to the production of such an effect, but a downward vortex of considerable magnitude having taken place to the south-west of Philadelphia on that day, from the upper cold northern current, which was then actually blowing, as appeared from the clouds.

Who has not observed the wind increase in violence, on the approach of a cloud, particularly in the spring, when upper northern currents prevail? A vortex downwards would account for both the cloud and the wind. In such cases, I have more than once known the dew-point to sink three degrees in a few minutes, and rise again when the cloud had passed away. This latter effect was no doubt occasioned by the vapour of the surrounding air rushing, by its elasticity, into the cold, and comparatively dry, air of the vortex; or, if it should be found by experiment that the motion of vapour through air, from a high to a low dew-point, is too slow to produce the effect of condensation, perhaps the mingling of the air of the vortex with the surrounding air, may be considered sufficient.

Again, if meteors are formed, as here indicated, from an upper current, coming from some northern point, and containing less caloric to the pound than the air below, it will account for some remarkable circumstances known to exist, as will appear by consulting the various annual reports of the regents of the university, to the legislature of the state of New York, from '27 to '31, inclusive. First, a degree of cold sometimes occurs much greater in patches, or small areas, at no great distance from each other, than it is in the intervening spaces at the same time. For example, a severe frost, which killed vegetables, took place at Albany, Hamilton, and Ithica, on the 10th and 22d of May, 1830; at Cambridge, on the 9th, 10th and 23d; at Canandaigua, on the 9th and 21st; at Fredonia, on the 9th and 22d; at Canajoharie, on the 10th; at Cherry Valley, on the 10th and 23d; at Franklin, the thermometer was 24°, and the ice one-fourth of an inch thick, on the 26th—there was also frost on the 22d, at the same place; at Kinderhook and Lansingburg, on the 10th and 23d; at Lowville, on the 9th and 20th; at Middleburg, on the 8th and 24th; at Oxford, on the 22d; at Union Hall, on the 10th; at Washington, on the 13th;

and at Cazenovia, on the 22d. It is not a little remarkable, that on these same nights, nearly, the aurora was seen in the same insulated way, at some of the observatories in New York, and not at others. It was seen on May 9th, at Canajoharie and Hartwick; 10th, at Kinderhook; 11th, at St. Lawrence; 13th, at Delaware; 14th, at Canajoharie, Hartwick, Pompey, St. Lawrence, and Utica; 15th, at Delaware, Kinderhook, St. Lawrence, Union, Cazenovia, and very bright at Utica; 19th, at Fredonia; 22d, at Union.

The appearance of the aurora on these nights of great cold, in connexion with the insulated manner of its appearance, affords another link in the chain of evidence, that this meteor is low in the atmosphere, and also that it is probably connected with the sudden reduction of temperature which occurred about those times, at various places, in the same insulated manner.

It will be readily granted by the reader, that, if an upper current of air should overlap an under one at the surface of the earth, containing, under the same pressure, thirty or forty degrees of caloric less than the one below, the equilibrium would be unstable, and a vortex would as certainly be formed, in such case, as it would be in water, if it were evenly spread over oil, and nicely balanced, at the moment of the first agitation.

But he will very naturally inquire, how can such an upper current be formed, especially when it is known, both from theory and observation, that the uppermost strata of the atmosphere are in constant motion from the south-west, throughout the whole northern temperate zone. For answer to this question, I will refer him to a subsequent number of this journal, where, in my essay on hail, he will find that I have demonstrated that the quantity of caloric evolved by the condensation of vapour into rain, causes about five times as much expansion in the air containing the vapour, as condensation by the change of vapour to water.

From this fact alone, he will readily perceive that in all rains there is an expansion of air in the region of the cloud, and of course an upward motion, and that the velocity of this motion will be in proportion to the quantity of vapour condensed in a given time. From hence will follow an outward motion in the upper part of the cloud, and an inward motion in the lower part of the cloud; and this motion will continue as long as the rain, snow, or hail, and a little longer, from the nature of inertia.

Thus, if we have a great rain to the north, a current of air will be formed at the surface of the earth from the south, and an upper (not the uppermost) one from the north. This upper current, at first, may contain as much caloric to the pound as the air below, and perhaps more, from the great quantity of latent caloric given out by the condensation of the vapour it contained; but that part which overlaps, after the rain ceases, will be very cold, for a reason given in the first part of this paper. It is not a little remarkable that meteorologists have universally taken it for granted, that the whole effect of a rain is to produce a condensation of the air in the region of the cloud, when a moment's reflection would have shown them that every pound

of rain that falls, heats up 100 pounds of air forty degrees, or in that ratio, as more or less should be heated. For it is well known to them that a pound of steam is capable of heating one hundred pounds of water, when the steam is condensed in it ten degrees; and as the capacity of air for caloric is only about one-fourth that of water, it will heat up one hundred pounds of air four times as many degrees, nearly; and in case the vapour is turned into hail, or snow, a pound of it will heat up one hundred pounds of air, about forty-six degrees.

It will be readily seen, without a formal demonstration here, that the sudden rarefaction of the air, in some cases of rapid condensation, will be sufficient to cause a vortex upwards of very great velocity, sufficient to carry large drops of rain up to a height far above the region of perpetual congelation, and thus produce *hail*. But, as this *grand* principle has been fully explained in my "Essay on Hail," I only touch upon it here to illustrate the manner in which an upper current of air may be formed contrary to a lower one. This hypothesis of an overlapping current may be verified, or overturned, by ascertaining whether, or not, there was a great rain to the north-west of the United States, some days previous to the 13th of November, 1833.

Many other facts might be adduced, which strongly favour the conclusion that, in all cases of rain, or hail, or snow, there is an upward current of air in the region of the cloud, in consequence of the great rarefaction of the air, by the evolution of the latent caloric of the vapour, and of course an outward motion of the air at the upper part of the cloud, and an inward motion at the lower part, in many cases, where the dew-point is high, reaching down to the surface of the earth, and also that this upward motion of the air is the *cause* of these depositions; but it would be out of place to mention them here.

On the Influence of the Moon upon the Weather, from a Lecture before the Class of the Franklin Institute, delivered March, 1834. *By* G. Emerson, M. D.

There is perhaps no opinion relative to the phenomena of the natural world, more universally maintained, than that the moon exerts a decided influence over the states of the weather. This long cherished notion has doubtless derived increased strength, since it was shown that the ocean tides depend upon a physical connection subsisting between our planet and her satellite.

I, however, think it capable of conclusive demonstration, that the moon exerts no influence in the production of wet or dry weather.

I assume it as incontrovertibly proved, by the experiments of Mr. Dalton, that the watery vapour from which rain, and all the precipitations, are formed, owes its elevation and suspension in an invisible form, entirely to heat, deprived of a due proportion of which by any refrigerating cause, it is condensed, and falls from the atmosphere in

one or other of the forms of aqueous precipitation. *The conditions of wet or dry weather are, consequently, to be regarded as regulated solely by temperature.*

Now, the nicest experiments have failed to show that the presence and light of the moon are attended by the slightest change of temperature. The lunar rays have been concentrated by powerful lenses, and the largest reflectors, and thrown upon that most delicate test of heat, the differential thermometer, without any indication of their effect in raising the temperature. Unless, therefore, it can be proved that the moon exerts some perceptible influence upon the temperature of our atmosphere, we shall be warranted in believing that she has no power in determining the conditions of the weather, whether this shall be wet or dry.

I am fully aware of the multitudes of observations which have from time to time been made upon this question, and that most of those reported appear to favour a belief contrary to the position here taken. Those collected by the celebrated Schubler, for example, made in several parts of Germany, during a series of no less than twenty years, and of Pilgram, of Vienna, embracing a much longer period, seem to have led the most intelligent men of the day into the unhesitating belief, that the quantity of rain bears a relation to the lunar phases.

Perhaps no one, at the present day, stands so deservedly high as a meteorologist, or has done so much to extend a knowledge of the agencies operating in the atmosphere, as Mr. Daniell, of London. His essays constitute a treasure, to one fond of tracing out the rationale of aerial phenomena, and especially of those connected with the atmosphere of vapour, as founded upon the principles of Dalton. But upon the subject of lunar influence in modifying atmospheric changes, he is confessedly obscure. That he does not reject the existence of such an influence, may be gathered from the following quotation:

"That the different phases of the moon have some connexion with changes in the atmosphere, is an opinion so universal and popular, as to be, on that account alone, entitled to attention. When to this result of universal observation, we add the philosophical reasons for the existence of tides in the aerial ocean, we cannot doubt that such a connexion exists. The subject is, however, involved in much obscurity. Mr. Howard is the only one who has treated it with the consideration it deserves."

He then enters into an investigation relative to the action of the moon, as connected with the principle of gravity, and appears to have sedulously avoided even a speculation relative to lunar agency in modifying the common changes of the weather. For this prudential course, he deserves to be commended; an observation which we would also extend to Dr. Prout, who, in a recent popular treatise, embracing much matter in relation to meteorology, has entirely waived the subject of lunar influence upon the atmosphere.

In the most recent set of rules for observing the barometer as a

weather gauge, we have seen published, the opinion of lunar influence is recognized in the following terms:

"During the increase of the moon, there seems to be a greater disposition, or effort, in the air for clear dry weather, than in the wane; but this disposition does not usually commence till about three or four days after the new moon, and ceases about three or four days after the full moon."—*Walker.*

And even in a late inquiry, by M. Arago, in which so much evidence is furnished to disprove the agency of the moon in many of the phenomena usually ascribed to her, we find this distinguished philosopher admitting her influence upon the weather. Alluding to the multiplied observations that have been made upon the subject, he says: "Confining ourselves to the principal results, it seems difficult to resist the conclusion that the moon exercises an influence on our atmosphere; that, in virtue of this influence, rain falls more frequently towards the second octant, than at any other epoch of the lunar month; and lastly, that the chances of rain are fewest between the last quarter and the fourth octant."

But let us see whether it be not probable that even M. Arago has, on this point, fallen into the error he elsewhere condemns, of ascribing effects to wrong causes.

It cannot be denied that the power of the moon, so conspicuously manifested in the production of the ocean tides, may also be felt by the atmosphere. The aerial ocean must, weight for weight, be as subservient to the law of attraction subsisting between the earth and her satellite, as any other terrestrial matter; and I have no doubt of the correctness of the results of observations made in Italy and France, by Polina, Flaugergues, and others, which go to prove that the mean height of the barometer is affected by the different positions of the moon in relation to the earth, the greatest mean elevations corresponding with the quarters.* But, in thus admitting the existence of lunar influence upon the terrestrial atmosphere, we should not deceive ourselves in regard to the *nature* of this influence. We must not admit that every cause which operates in producing the rise or depression of the mercurial column, is capable of influencing

* The results of the calculations for the purpose of ascertaining the mean heights of the barometer, at the various lunar periods, are as follows:

Those made at Padua, by the Marquis Polina, extending over a period of forty-five years, were computed by Toaldo, who found that the mean height at the quarters was greater than that at the syzygies, by a difference of 0.46 millimetres.

Those of Flaugergues, made at Viviers, in France, and comprising a period of twenty years, gave the mean height at the quarters, 0.42 millimetres greater than at the syzygies.

Those made at the Royal Observatory, in Paris, and calculated by Bouvard, gave a difference of 0.69 on the same side.

The mean of these three estimates is 0.52½ millimetres, as the height at the quarters over that at the syzygies; a small difference, indeed, but still one that is fairly appreciable. We regard the general agreement such as to render the minute differences in the respective results a matter of minor importance, and not sufficient to invalidate, but rather to confirm, the evidence.

the hygrometric conditions of the air, or, in other words, exercising an influence in the production of wet or dry weather. The attraction subsisting between the earth and moon, causes an accumulation of the liquid and movable materials spread over the terrestrial surface, on that part addressed, towards the moon. Hence the rise observed in the sea, and in the mercurial column. But all this is owing to the agency of *gravity*, or *attraction*, which, we contend, has nothing to do with the production of wet or dry weather, the elevation and deposition of aqueous vapour being, as we have said before, subject to the agency of temperature alone.

As to the calculations, the results of which, even with such investigators as Arago and Daniel, seem so irresistibly in favour of lunar influence upon the weather, we think it easy to show that they must be founded upon deceptive data, and will not bear a close examination. The estimates of Toaldo, a celebrated Italian philosopher, embrace a series of laborious observations, collected during many years, and compute the number of *changes* of weather to the different phases of the moon, as follows:

New Moon,	6 to 1;
Full Moon,	5 to 1;
First Quarter,	2 to 1;
Second Quarter,	2 to 1;
Perigee,	5 to 1;
Apogee,	4 to 1.

That is to say, of seven new moons, six were attended with a change of weather, and at one of them there was no change; of six full moons, five were attended with a change; and at the quarters, the changes were twice as frequent as the continuance of the previous weather.

Now, such a computation, coming from so high an authority, might almost be deemed conclusive upon the subject. When, however, we come to inquire more closely into the circumstances involved in the calculation, we find ample grounds for suspecting its accuracy. In the first place, the term "*change of weather*" is used by Toaldo in an ambiguous and arbitrary sense, so that we are left ignorant of the specific change he refers to. But worse than this, he does not restrict himself to the day when the change takes place, but includes any changes within two or three days preceding or following a phase. It is easy to conceive how a person, especially one prepossessed in favour of a prevailing opinion, might have been led, with such a privilege, as to limits, to take or reject a change, to throw it into one quarter or another, as he might choose to dispose of it, for the purpose of endowing the moon with a power to which he thought her entitled.

The results of a series of observations made by Pilgram, make it appear that the new moon has less to do with the changes of the weather than the other phases; a conclusion diametrically opposed to that of Toaldo, just referred to. As the estimate of Pilgram is founded on observations extending through a series of no less than fifty-two years, it might be regarded, in point of authority, as at least equal to that of the Italian philosopher. How are these clashing

results of observations, professing to be made with the utmost attention, to be reconciled with truth? Do they not leave us to infer that the data employed have been either deceptive, unskilfully grouped, or that some incidental or accidental circumstances have interfered with the estimates, and led to erroneous conclusions?

The belief in the moon's influence over the natural operations going forward upon our earth, has by no means been confined to the weather; and it would be a tedious task to enumerate all the agencies she has been allowed to possess over organic and vegetable life, both animate and inanimate. "Many of the opinions vulgarly entertained upon this head," says M. Arago, "are founded on well established facts, the error lying, not in the observations, but in the theory which makes the moon the *cause* of phenomena, of which she is only the silent and unconcerned spectator." The distinguished philosopher from whom we have just quoted, has cited a number of highly interesting cases, which show in the clearest manner how the effects that have been ascribed to the moon's influence, can be readily traced to natural agencies, operating around us, and with which modern philosophy has rendered us familiar. Such, for example, as the pernicious influence upon vegetation, attributed, by gardeners and agriculturists, to the April moon, the effect of the moon's rays in hastening the putrefaction of animal substances, &c.; all of which effects are doubtless connected with the presence of moonlight, merely, however, as an incidental circumstance, for they would take place equally well in a clear atmosphere, even should there be no such body as the moon in existence.

Let us take, for example, the case of the April moon, denominated, by the French gardeners, "la lune rousse." The *change* in this case takes place in April, and the *full* either about the end of this month, or some time in May; at which particular season, in our climate, the mean temperature of the air is but little above the freezing point. Under these circumstances, the radiation from the earth, during a clear night, will often reduce its temperature to, or even below, the freezing point; whilst a thermometer suspended in the air, a few feet from the ground, will remain several degrees above 32°. Thus, the tender plants in the soil may become actually frost-bitten, whilst the atmosphere has been apparently too warm to admit of such an occurrence. If, on the contrary, the night be cloudy, the plants will suffer no injury, not, as the gardeners allege, because there is no moonlight to hurt them, but because the radiation and cooling of the earth will not take place. Thus, moonlight or starlight, the injury to vegetation will be precisely the same, and the effect might as well be ascribed to the stars as to the moon.

And again, it has been noticed by Pliny and Plutarch, and is generally believed in most countries, at the present day, that the moon's light sheds a copious humidity on substances exposed to its rays, and hastens the putrefaction of animal substances. That a copious humidity is often shed during a moonlight night, is not to be disputed; neither can it be doubted that meats will spoil sooner, if exposed to her rays, than if protected from them. The nature and source of

this humidity can be no mysteries, now that the rationale of the formation of dew is so happily explained; and it is sufficient to say, that the moisture deposited upon the meat, causes it to spoil much sooner than if kept covered, when it would remain dry. Meats are constantly preserved by simple drying, and even the mummies in the dry caverns of Egypt have lasted thousands of years, mainly from their depositories being perfectly free from moisture. The preserving agency of embalming is, perhaps, a secondary consideration, when compared with the subsequent state of dryness in which the bodies are kept.

As to the notion of lunar influence on disease, which still counts numerous partisans, and upon the existence of which a book has lately been published in England, we regard it, notwithstanding the authorities of Galen, among the ancients, and Mead, Hoffman, and others, among the moderns, as upon precisely the same footing as the exploded doctrine of the agency of the stars, so long and stoutly maintained.

Upon the whole, therefore, I look upon it as clearly demonstrable, upon established philosophical principles,—

1st. That wet and dry weather, with all the influences concerned in the deposition or suspension of vapour, are matters regulated solely by changes of temperature, over which the moon has no control.

2dly. That most, if not all, the effects upon animal and vegetable substances, popularly ascribed to the action of the moon, are to be traced to natural agencies, entirely independent of this satellite.

FRANKLIN INSTITUTE.

Monthly Conversation Meeting.

The fourth conversation meeting of the Institute, for the season, was held at their Hall, Jan. 22d, 1835.

Mr. S. V. Merrick exhibited a gas meter, which had been brought by him from England, for the examination of the City Councils. The front of the revolving cylinder being of glass, permitted a view of the interior of the apparatus, the compartments of which, with the entrances and exit openings, were characteristically coloured.

Messrs. B. Slater & Co. deposited for examination, a machine for shearing cassimeres, invented by Mr. Samuel Parsons, of Hosick Falls, New York, combining some parts which are considered as improvements, and the work done by which is highly commended.

Mr. Titian R. Peale presented specimens of his method of securing specimens of butterflies from the depredations of insects; he stated that a splendid collection of this kind, which had existed in Paris in the year 1812, had been, within the interval of ten years, entirely destroyed. The specimens are attached by small bits of cork to panes of glass, made perfectly clean, and which form the transparent sides of boxes intended for the exhibition and preservation of the specimens; the insects which prey upon the specimens,

not being able to move upon the perpendicular panes, are not able to pass from one specimen to another; and if even their eggs should have retained vitality under the preliminary operations of baking at the heat of boiling water, their destructive action is confined to a single specimen.

Mr. George P. Schively deposited for examination, a cancel hammer, which was stated to have been the work of an apprentice of less than one year's standing, and which was very much admired for the style and finish of the workmanship. He also deposited a pair of skates, which were much approved of for their correct shape and finish.

Mr. Rufus Tyler exhibited the shifting gauge for steam boilers, for which the award of a premium from the Scott's legacy had been recommended by the Committee on Science and the Arts, to the inventor, Mr. Philos Tyler. A report upon this, by the committee, will be found on page 178 of this Journal.

Prof. A. D. Bache showed the experiments relating to the production of a spark from a single galvanic circle, by interposing a long conductor between the poles, and stated the explanation given by Prof. Henry, to whom the discovery of the facts was due. A notice of these several points will be found in the March number of this Journal.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Mr. M. W. Baldwin's Locomotive Engines.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination certain improvements in Locomotive Engines, made by Mr. Matthias W. Baldwin, of the city of Philadelphia, REPORT:—

That they have examined several of these engines, which are now being built in Mr. Baldwin's workshop, and find in them numerous improvements, affecting nearly every part of the machine. The first they will notice, are in the position and construction of the force pumps, which supply water to the boiler; the guides of the piston rods are made hollow, and the cavities are used for the chambers of the force pumps, thus giving additional strength to the guides, without much increasing their weight, and dispensing entirely with the frame and fixtures of the ordinary force pumps. Each of these pumps is furnished with five valves, three of which are situated between the boiler and the piston, and two between the piston and water tank. The valve nearest the boiler is loosely swivelled to a stem, passing through a steam-tight collar in the top of the valve box, by means of which the valve can be sounded, and, in most cases, freed from obstructions.

The other four valves are contained in one box; this box is secured to the pump by a stirrup, which can be removed by loosening a single screw, so that the valves can be taken out, cleansed, and replaced, in a few minutes. By thus increasing the facility of ex-

amining and cleansing the valves, and thereby diminishing the liability of the force pumps to obstruction, the supply of water to the boiler will be rendered much more regular and certain; and the chief cause of those fearful explosions incident to steam engine boilers, will be in a great measure removed, as it is confidently believed that these accidents are generally the result of a deficiency in the supply of water.

Another improvement consists in the manner of reversing the motion of the steam valves. This is done in the English engines by means of a treadle, and a series of levers, which move the eccentrics laterally on the propelling axle, after the hooks of the eccentric rods are thrown out of gear with the rock-shafts. In Mr. Baldwin's engines, the arms of the rock-shafts extend on opposite sides of the fulcrum, and each eccentric rod is furnished with two hooks, turned in opposite directions, so that it may be geared to either arm of its rock-shaft; the eccentrics are fixed immovably upon the axle, and the eccentric rods, instead of being carried (as they usually are) to the front of the engine, are brought to the stage at the hinder part, and there geared to either arm of the rock-shafts, at the option of the engineer. When the hooks of the eccentric rods are geared to the same arms of the rock-shafts as the valve rods are, the motion of the valves corresponds to that of the eccentrics; if they be geared to the opposite arms, the motion of the valves will be reversed; and if they be not geared to either arm, the rock-shafts and steam valves can be worked by the hand levers. The advantages of this arrangement are several; the eccentrics being firmly secured to the axle, are less liable to get loose, and out of repair; it dispenses entirely with the treadle, and its appendages, and also with four rock-shafts, and the complicated hand gear of the English method.

But the most important benefit is, that the rock-shafts and eccentric hooks are placed immediately under the eye, and within the reach of, the engineer, which is not the case in the ordinary arrangement.

The axle of the driving wheels has also been made the subject of improvement by Mr. Baldwin. Instead of fixing the ends of the axle into the centres of the wheels, as is usually done, he dispenses with one of the arms in each crank, and fixes the wheel upon the wrist of the crank, with its centre adjusted to the centre of the axle. By this change in the form of the axle, the power of the engine is applied directly to the wheel, without the intervention of an arm of the crank, thus diminishing the strain upon the axle, and, consequently, lessening its liability to be broken. By this means, also, Mr. Baldwin has, in some measure, obviated the tendency of the driving wheels to twist upon the axles, and become loose; a very general and troublesome defect of locomotives. Another good effect resulting from this change, is, that the distance between the two cranks is increased about ten inches, which will admit of a corresponding enlargement of the boiler, and of a more advantageous disposition of the weight of the fireplace, by bringing it about fourteen inches nearer to the axle. In these engines, the steam pipe is intro-

duced into the boiler through the opening by which it usually communicates between the dome and the cylinders; and the end of the pipe beneath the dome is supported on a horse, fixed within the boiler, so as to admit of its longitudinal expansion and contraction by changes of temperature; and to avoid inconvenience from the same cause, the stop of the throttle valve is fixed on the steam pipe, instead of the head of the boiler. A twofold benefit is derived from this plan of introducing the steam pipe; first, the pipe may be made without a joint within the boiler; and secondly, a man hole in the boiler may be dispensed with; for the juncture between the dome and boiler, as well as all the other steam joints, being accurately fitted by grinding, and formed without any cement, or packing, the dome can easily be taken off and replaced, and its aperture used for occasional access to the inside of the boiler.

In the construction of his driving wheels, Mr. Baldwin uses hubs and spokes of iron, cast in one piece; felloes of hard wood are framed into the ends of the spokes, and the whole is firmly bound together by a stout tire of wrought iron, with a flanch on its inner edge; thus, by a judicious combination of iron and wood, he has united the strength and firmness of the former, with the elasticity of the latter, so desirable in the tread of the wheels.

Mr. Baldwin has completed several engines, which combine all these improvements; one of them may be seen in operation on the Philadelphia and Trenton Rail-road, and four on the state road to Columbia; all of which, as well as one in use at Charleston, South Carolina, have given entire satisfaction by their performance.

The committee are informed that some of these improvements have been secured to their inventor by patents; and that he richly deserves to reap the benefit of them, will be admitted by any one who is aware of the present extensive use and increasing demand for these costly structures.

By order of the committee.

WILLIAM HAMILTON, *Actuary.*

February 12th, 1835.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1834.

With Remarks and Exemplifications, by the Editor.

1. For a *Perpetual Shoe Bench;* Samuel Haynes, Malden, Middlesex county, Massachusetts, September 1.

A long bench is to be made, which may be about three feet high; and from a platform on the floor, a row of standards, or uprights, are to extend up, through this bench, projecting above it to a sufficient height to receive the last in a notch, made for that purpose, on its upper end. These standards are to be about a foot apart, and for one workman there may be ten, or more, of them. Straps are to extend from the lasts, through holes in the bench, their lower ends

being attached to treadles near the floor; then, by placing the foot upon a treadle, the strap is strained so as to hold the last firmly down, and by slipping the treadle under a cleat, it becomes fixed. Shoes or boots which are to be wrought upon, are placed on the lasts, and all of them confined in the same position, each in its own standard; this is to enable the workman to pass from one to the other, alternately performing the same operation upon each, and thus avoiding the necessity of a frequent change of tools and position. The patentee says that, "in this mode, the operator will be able, in a given time, to manufacture and finish, in a complete, thorough, and workmanlike manner, more than double the number of shoes that he could in the usual mode of manufacturing."

"Some parts of the machinery herein represented and described, have been heretofore known and used;—I believe some parts of it are new; but not being sure of this, I claim no part of the machinery as constituting my invention; but my invention, which I hereby claim, and for the exclusive right of which I now desire letters patent, is, *a combination of machinery to produce a new and useful result.*"

Although there certainly is no great portion of invention in this contrivance, we think that there is sufficient novelty in it to sustain a patent, which will be very valuable, if its utility is equal to, or approaches in amount, that stated by the patentee.

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2. For an improvement in navigation, called the *Cylinder Boat;* Amos Kendall, city of Washington, District of Columbia, September 2.

The basis of this boat, or that part which touches the water, is to consist of two, or more, hollow, water-tight cylinders, stretching across, and under, it; which cylinders are to be of such dimensions as may be required by the size of the boat. They are to be covered, or surrounded, by paddles, or floats, extending from end to end, but divided into sections, so arranged that no two of them shall strike the water at the same instant.

The body of the boat is to rest upon two side timbers, on the under surface of which the gudgeons of the cylinders are to revolve in suitable boxes, or upon friction rollers. Motion is to be communicated to the cylinders by means of cranks, chain wheels, or other gearing. The cylinders may be divided into two sections, with the cranks, or chain wheels, in the centre; or if continuous, the power must be applied at one of their ends.

The grand result of a vessel thus constructed, is, that its whole weight rests entirely upon the axes of the cylinders, these cylinders taking the place of both the hull and paddle wheels in ordinary boats, the progressive motion being obtained by the rolling of the cylinders within the water; "the advantage expected, is greater speed with light loads than is attainable in the present mode of navigation." "The improvement claimed, is the use of revolving cylinders, with paddles in sections on the outer surface, to supersede the hull and

paddle wheels, (or other machinery for the same purpose,) of the common boat."

On the 23d of April, 1834, a patent was obtained by Mr. Anthony Plantou, for a new mode of constructing and propelling steamboats, &c., which is noticed at p. 334 of the last volume; that gentleman proposes to employ similar hollow air-tight cylinders, with floats, or buckets, in conjunction with hollow buoyant trunks, which, in combination with the cylinders, are to sustain the load.

When it is recollected that but a small portion of a paddle wheel can be allowed to dip into the water, it does not appear that cylinders, such as are described, can be employed, without making them of a diameter which shall mount the boat high in air. Such cylinders, we believe, would sink as deep as is allowable, by their own weight alone; and even with the addition of the hollow trunk proposed by Mr. Plantou, we do not believe that this objection would be entirely removed. "Paddles in sections" have been patented by the Messrs. Stevens, of New Jersey, and, we presume, have been so claimed by them, as not to admit of their use by others.

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3. For a *Thrashing Machine;* Israel Lukens, Upper Dublin, Montgomery county, Pennsylvania, September 2.

This is the usual cylinder and concave machine, upon each of which parts smooth iron bars are to extend from end to end, the cylinder being borne up against the concave by means of springs, thus causing the grain to be rubbed between them by the revolution of the cylinder. Spikes are also set upon the latter, to draw in the straw, and keep it straight.

A smaller cylinder, also furnished with iron bars, revolves close to the periphery of the larger, but with a slow motion, being driven by a cog-wheel on the main cylinder shaft, gearing into one of three times its size on its own shaft; upon this rests a second small cylinder, or roller, which is borne down upon it by springs, and receives its revolution from the action of the iron bars of that upon which it rests. "These cast wheels, rollers, and springs, are also claimed as part of the invention," which is all that is said about the claim, leaving us at a loss respecting what else is considered as making a part of the invention, which is unfortunate, as, in it, there is much of antiquity accompanying whatever there may be of novelty.

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4. For an improvement in the application of steam to the purpose of cooking, called the *Steam Baker;* Charles F. Wilcox, Springfield, Hampden county, Massachusetts, September 3.

A steam boiler is to be made by taking two cylinders of iron, one smaller than the other, placing them concentrically, and uniting them by a rim at top and bottom. The space between these cylinders is to contain the water, and the interior cylinder forms a part of the body of the furnace. "The space between the two cylinders, for the generating of steam, must be adapted to the size of the apparatus. In one eleven inches in diameter, and seven inches deep, the space

may be one inch wide." In an aperture near the top, a tube is inserted to supply water. The boiler is to be placed on a stand, forming an ash pit, with grate bars to support the fuel. On the top of the boiler there is to be a cast-iron dish, or skillet-like vessel, and this is to be furnished with a tin cover, forming, with the dish, an oven, or cooking chamber. On one side of the boiler, at its upper edge, a brass cock is to be inserted, and a tin tube, with suitable joints and elbows, is to conduct the steam from this cock into the oven, or cooking chamber, an opening being left in the tin cover for that purpose.

"The improvement consists in the mode of conveying the steam, and in connecting the steam with the heat from the furnace, in one operation."

This may really be an improvement in the mode of cooking, but we confess that there appears to us to be more of contrivance than of utility about it; we are much mistaken, therefore, if it is destined to find favour with the kitchen comptrollers.

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5. For machinery for *Cutting Crackers;* Lucius Kirtland, New Haven, New Haven county, Connecticut, September 4.

This machine, as the title indicates, is employed only for the *cutting* of crackers, as no mention is made of rollers for rolling the dough to a proper thickness, in the manner of most of the machines previously patented. A frame is made, by taking two planks to form the cheeks, which may be about ten inches wide, and extend from the floor to the ceiling, at the distance of about seventeen inches apart. A cutting board is framed into these, at the height of about three feet from the floor, the surface of which board is to be covered with sheet lead. The cutters are made of tin, and are fixed on to the lower side of a board, which, with the other parts of the machinery, slides up and down between the cheeks. A machine of this size may contain twenty-eight cutters.

Within the cutters there is a piston, called a cracker discharger, consisting of a rim of block tin, with three arms, uniting it to its centre, into which a rod is fixed, extending up vertically; and between the arms of this discharger, docking wires are placed. Similar pistons are employed to force out the scraps of waste dough from between the cutters. The cutting board, the cutters, and the carriage to which they are appended, are brought down by means of a treadle, and raised by a weight at the upper part of the machine, connected with the carriage by ropes passing over pulleys. The dough is to be placed on the cutting board by the aid of a paddle, or shovel; the cutters are then brought down by means of the treadle, and the crackers are consequently cut and docked; on allowing the carriage to rise to a certain height, the cracker dischargers operate, and push out the crackers on to a paddle, placed under to receive them; they are then ready for the oven; on the rising of the carriage a little higher, the scrap dischargers push out the waste dough from between

the cutters, which is removed from the board by passing in the next paddle with dough.

The inventor does not claim "the cracker cutters, and cracker dischargers, as heretofore used and worked by hand; but claims the scrap dischargers as wholly new, and the cracker dischargers as above described, and operating by machinery; and also the combined machinery as above specified, by which the crackers are cut and pricked, and the crackers and scraps separately discharged by its operation."

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6. For an improved press, for *Pressing Cheese;* Elijah Barnes, North Brookfield, Worcester county, Massachusetts, September 5.

A single screw is to force down a follower, upon the cheese, within its hoop, and placed upon a suitable bed. One advantage of this press, we are informed, is, that if the frame and bench be made long enough, and there be a sufficient number of screws, any number of cheeses may be pressed at the same time; a piece of information, most assuredly, of the utmost importance. We are told, also, that "The screw presses are considered preferable, by experienced dairy people, to those with the pulley, or lever, because they are liable to press too hard at first, and, consequently, force out the whole whey, or goodness of the cheese." Were we fond of notes of admiration, we certainly should place a few at the end of these quotations; we know of no other novelty in the affair than is to be found in the opinions of the patentee, who has left us to guess at what he ought to have claimed; we, however, refer this question to "experienced dairy people."

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7. For a machine for *Hulling Barley;* Henry Handschey, Bridgeville, Muskingum county, Ohio, September 5.

A frame is to be made, to contain a row of stampers, which slide in mortises made in horizontal pieces, attached to the frame. Below the stampers, in the sill of the frame, there are excavations forming mortars to receive the barley. The stampers are to be raised by wipers, projecting from a revolving axle, which catch against pins. This constitutes the whole of the machine, in which there is about as much novelty as there is in a common rolling pin, or a clothes horse.

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8. For *Wheels for Carriages, &c.;* Barney Ruggles, Warsaw, Genesee county, New York, September 8.

A wrought iron rim, and an iron hub, are to be connected together by spokes formed of spring steel, bent into a curve. These spokes are to be attached to the rim, and to the hub, by screws, rivets, or otherwise. This is all the information given upon the subject of the invention. Wheels similar to these were made about two years since, and attached to a fire engine, by the late Joel Eastman, who expected that they would, by their elasticity, operate

as springs, and afford some relief in the motion of that apparatus; they are, we believe, still in Georgetown, D. C., where Mr. Eastman died.

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9. For a *Shoe for Mill Cans;* James Dennis, Providence, Rhode Island, September 8.

The mill-can-shoe is a ring of either cast or wrought iron, and is intended to protect from injury the bottoms of the cans, and the floors on which they are used. This ring is furnished with a flanch, or projecting ears, by which to attach it to the can. The patentee "claims the shoeing mill cans with cast or wrought iron, or other metal, and the form of the shoe above described." As respects form, it is said that the ring may be half an inch, or more, in width, and that it may be "concave, convex, or convexo-plane." Mr. Butterworth, of Philadelphia, obtained a patent for a similar contrivance, some years since.

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10. For a *Circular Saw Mill;* John Penman, Charlotte, Muhlenburg county, North Carolina, September 9.

After describing the frame-work, carriage, and mode of gearing, in this mill, the patentee claims one part only of the whole, and in this, unfortunately, he has long since been anticipated. He says, "My claim consists in the application of two circular saws, one above, the other below, operating in the same plane." Saws so placed have long been in use in England.

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11. For *Lessening Friction, by friction rollers;* Isaac Clowes, Norfolk, Norfolk county, Virginia, September 9.

It has, more than once, happened that contrivances for lessening friction, have actually produced the reverse effect; and should the plan now proposed be carried into operation in "steamboats, grist mills, carriages," &c., another example of such an effect will be added to the existing list. In the principle upon which the present patentee depends, there is not any thing of novelty, as it consists merely in the revolution of the axle of one wheel upon the periphery of another; and whatever there may be of novelty in the arrangement, or rather in the complication of the parts as contrived by the inventor, will not be accompanied by any portion of the utility he anticipates. He informs us that there are to be eight, or more, frames made of metal, to contain the rollers which are to be employed; that seventeen large friction rollers are to be sustained between four of the frames, and that there are to be seven movable metal boxes to each frame, in which fourteen of the friction rollers play, surrounded by small friction rollers in each box; and much more to the same effect. The claim is to "the preventing the axles, or gudgeons, from wear, by applying composition or metal boxes of any kind, stationary or otherwise, around them; and the method of applying the large friction rollers, with the frames and movable boxes, and with or without the small friction rollers under the gudg-

eons of the large friction rollers, which are not immediately under the axles of cars, or gudgeons, &c., as usual, or heretofore applied, preventing both friction and wear." If the patentee can discover some materials which are perfectly hard, and perfectly inflexible, and a workman who can give to such articles a finish perfectly smooth, and perfectly true, he may derive some advantage from his contrivance; should he not do this, he will find that when he gets one of his complex friction boxes into actual operation, not one-half of the rollers will turn round when there is any load upon them, and that, after a little while, his circles will be converted into polygons.

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12. For improvements in *Locomotive Engines, and Cars for Rail-roads;* Matthias W. Baldwin, Engineer, Philadelphia, September 10.

This patent is obtained for several improvements, which are claimed in the following words:

"What I claim as my improvement in the respective parts of locomotive engines and cars, herein described, is, first, the manner of constructing the crank, and inserting the wrist thereof, prolonged, into a socket in the wheel, or otherwise attaching it thereto, for the purpose of obtaining the advantages set forth. Secondly, the casting the wheel with the arms, or spokes, separate from each other, and attaching them to a rim, or felloes, of wood, by separate flanches. Thirdly, the manner of constructing the pump chamber, so as to fit it together without any packing, and to confine the respective parts in their places by means of a stirrup, operating in the manner described; and also, the forming the chamber of the pump itself within one of the guide pieces. Fourthly, the general manner of constructing and adapting the junctures of steam, or other, tubes, without packing, as set forth; not intending, however, in either of the cases referred to, to confine myself to the precise form and construction represented in the drawings, but to vary the same in any way by which I may be able to attain the same ends by analogous means."

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13. For a *Brick Machine:* Cyrus Chaney, North Prospect, Waldo county, Maine, September 11.

This machine for mixing clay and moulding bricks, differs but little, either in principle or arrangement, from some others in the patent office. The claim made is to "The combination and arrangement of the several parts of the machine."

The clay is to be mixed by the turning of a vertical shaft in a cylindrical box, knives projecting from the shaft and the sides of the box in the ordinary way. The mixed clay passes out through an opening at the lower end of the box, on one of its sides, where it is received into another box, whence it is forced down, by means of a follower, into moulds placed upon a carriage, admitting of their being easily changed. Those who have paid attention to the various machines patented for this purpose, will perceive that this general description does not include any thing of novelty; under these circum-

stances, it was incumbent on the patentee to designate the particular points in which his machine differs from others; the law absolutely requires that this should be done, and without it, there can be no such thing as an infringement of his patent.

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14. For a *Stove;* James Wilson, city of New York, September 12.

The petition alleges that this patent is taken for "an improvement in the construction of the union, or double, grate, connected with stoves of various forms and kinds, for the burning of anthracite or bituminous coal, for heating rooms in all their varieties and forms, and for all culinary purposes; with an entirely new constructed feeder, or hopper, adapted to all the varieties of stoves and furnaces."

The specification, as may be imagined from the foregoing announcement, is one of considerable length, referring not only to ordinary stoves for warming, and cooking, but also to cupola, and other furnaces; but this is done without an adequate acquaintance with the structures spoken of, and without the application of any common principle to each of them, which could legitimately bring them within the compass of a single patent. The claims alone occupy more space than we think proper to afford to this article, and we will, therefore, offer an epitome only, of them.

They are made to the guarding the ovens of all cooking stoves from burning at bottom, by a second plate, placed under them. To a mode of directing the fire to the boiler, and to the upright parts of the oven plates. A sliding guard plate, connected with a sheet iron, or other flue for tinning sheets of copper, and thereby regulating the action of the fire. The construction and mode of fixing a sliding or revolving damper. The saving from breaking all stoves or cast iron plates, by curving the same at least the thickness of the plates. These claims, with much other matter, relevant and irrelevant, apply to the cooking stoves, which, though last in the specification, we have accidentally taken up first.

The union grate, as described, is claimed; also the manner of discharging the same by means of a swing, or drop gate, describing the quarter, or any segment, of a circle, &c. &c. The opening of the sides of the stove, for the admission of air. A movable damper, or valve, sliding under ovens.—Cast iron guard plates, separate from the sides or back of the stove.—An upper damper. After this comes the feeding of furnaces, and some other matters, about which we are convinced that our readers will not wish to hear; we therefore dismiss the subject.

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15. For an improvement in the *Horse Collar Block;* Dyer Cleaveland, Owego, Tioga county, New York, September 13.

A block is to be made in the usual form of those used by collar makers, and this, it is stated, may be either of wood, or of cast iron. The collar, with a rope passed round it in the ordinary way, is to be placed upon the block, and, by means of a screw, a slide, is made to

work horizontally in a groove along the middle of the block, is to be forced against the rope at that part of it which passes round the small end of the collar; after the collar has been properly shaped by the force of the screw, its two ends are to be sewed together, and again placed upon the block, that the slide may be forced against it a second time, to give it a final shaping.

On turning to No. 40, for the last month, p. 108, it will be seen that three patents have been obtained, within three months, for what is essentially the same thing; in the plan described in the specification before us, the rope is pushed, instead of being drawn, by a screw; but this is only a colourable difference, which any common mechanic might devise, without possessing the least talent for invention. From the circumstance of the entire similarity of the inventions, as well as from the residence of each of the patentees in the same state, and in counties not very remote from each other, the conviction that they are not all "true and original inventors," is irresistibly forced upon us.

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16. For a *Relief Bedstead*, for the use of invalids; David Anthony, Adams, Berkshire county, Massachusetts, September 13.

The bedstead described in this specification is furnished with most of the conveniences proposed in those which we have had occasion to notice, or which are described in the books. There is some variation in the manner of raising and lowering the different parts, but nothing essentially new. The patentee claims nothing more than the operating upon the various shifting parts in the manner described by him, and more than this he certainly could not sustain.

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17. For a new *Material for Stuffing Mattreses;* Elias Howe, Cambridge, Middlesex county, Massachusetts, September 13.

The material to be employed is palm leaf, which is to be separated into fibres by hatchelling, or otherwise; these fibres are then to be employed in the manner of horse hair, or corn husks, for filling mattreses. We are not aware of any superiority which the palm leaf possesses over the corn husk, which is a very good material, and one largely used for the purpose. It is not improbable that in the country of palms, some of the inhabitants have been in the practice of making their beds of these leaves, in which case the patent here would not be good, as the patentee has to sustain his claim against the whole world, and all time.

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18. For an improvement in the construction of *Water Cisterns;* Obadiah Parker, Syracuse, Onondaga county, New York, September 15.

This patent is taken for an improvement on the manner of constructing cisterns, for which a patent was obtained by Samuel Booth, of Syracuse, on the 20th of August, 1833, which patent, with some others for that year, was omitted in our list, in consequence of an

oversight in the patent office. We shall take an early opportunity of supplying this deficiency.

The present patentee says that instead of taking rough planks, and forming the cistern with these, and then plastering over them with the cement, he digs a hole, or pit, about a foot greater in diameter than the intended cistern, and prepares circular moulds, or drums, of the intended diameter of the cistern, and about two feet wide, one of which he places upon the bottom of the pit, and then plasters round it with hydraulic cement, to the thickness of three inches, carefully ramming in earth, all around, between the cement and the original ground, as the work proceeds. A second mould is then put upon the first, and secured to it by hooks and staples, and the operation continued until the desired height is attained, when the sections of moulds are removed. A floor is then formed of the same cement, mixed with gravel, or with stone, if preferred. Other moulds, adapted to the purpose, are employed upon which to form an arched top, from the same materials.

The improvement claimed "consists in forming and making the cistern of hydraulic cement, without having any wood, or perishable matter, left in or about it, and in the manner above specified, by means of moulds for the body and top, thereby making a more firm and perfect cistern, it being a complete cement jar; also, in making it above ground, and, as an improvement on said Booth's patent, claiming nothing therein to him patented."

This is the fifth patent for making cisterns of hydraulic cement, which has been obtained within little more than a year, and all of them by persons living in the same district of country. The first was that of Mr. Booth, above alluded to; the others are noticed in vol. xiii., p. 322, and vol. xiv., p. 25, and p. 232. The latter, patented by Messrs. Fortin and Van Vleck, is, in its mode of construction, in all essential points, identical with the one before us. In examining those previously patented, (with the exception of Mr. Booth's,) we have offered such general remarks as were suggested to us by the subject, and which, therefore, it is unnecessary for us to repeat. We shall, at an early day, append to our monthly lists, an account of the ten omitted patents, when, of course, Mr. Booth's plan will be described.

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19. For an improved *Reaction Water Wheel;* John L. St. John, Canajoharie, Montgomery county, New York, September 16.

The patentee states that he has invented a new form of wheels, and improved those already in use. In the new form, the wheels are to have openings at or near their edges, through which the water is to pass, entering them at top, and being delivered below, as nearly as may be at a right angle to the radii of the wheel, and at as small an angle with its face as possible; the wheel, of course, revolving horizontally, with a vertical shaft. The following proportions are given for a wheel of thirty-two inches diameter. Such a wheel may be

three inches thick, and have six openings for the passage of the water through it; when made of wood, the rim may be two inches wide, and the buckets eight; the centre, or unperforated part, of the wheel, will then be twelve inches in diameter.

Sometimes, it is observed, it may be best to allow the water to issue from the periphery, horizontally; that is, in the manner of the reaction wheels most commonly used; and directions are given respecting the manner in which it may be so formed.

The improvements which the patentee makes in wheels already in use, are stated to be four in number: First, using less lapping of the ends of the buckets than usual. Second, leaving less lapping by the sides of the issues. Third, altering the wheel, so that the water will not be pressed by it. Fourth, altering the wheel, so that the water can pass more readily to, and through it, without friction.

Some of the things proposed to be done, are not very clearly explained, whilst others are impossible; as, for example, the leaving of less lap in the buckets of reaction wheels than has heretofore been done, the fact being, that many of them have no lap at all. The new form of wheel described, is old; nor have the things claimed any common connecting principle to justify their being combined in the same patent. The drawing is altogether inadequate, and is without written references.

The claims made are to "The new form, or forms, of wheels, as described in the first part, and to the improvements as explained, and the various improvements as described, in the second part."

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20. For a *Handling Machine*, to be used in the manufacturing of Leather; William G. Waterman, Sullivan, Madison county, New York, September 16.

A reel, about eighteen inches in diameter, and ten feet in length, formed of slats, is to be sustained upon a frame, so that it may be made to revolve by means of a crank. The skins to be handled are to be tacked together, and whether in the process of liming, or tanning, they are to be deposited in the place required, by means of the reel.

We are much mistaken if such handling machines have not been in use in many tan yards, for a number of years.

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21. For an improvement in the form and construction of *Gridirons;* Fenner Bush, and Linus Pratt, Meriden, New Haven county, Connecticut. First patented July 21st, 1832. Patent surrendered, and reissued upon an amended specification, September 17.

For our observations on the patent, as originally obtained, we refer to vol. xi., p. 101. In the deed of surrender, the patentees state that their former claims, through inadvertence, included more than that of which they were the original inventors; their present claim is as follows.

"We do not claim that a revolving gridiron, merely, is a new invention, nor that a gridiron with only fluted or channelled bars, and

the transition rocks, contains the fossils which are characteristic of the lias formation. The alternation of this limestone with the sand stone, establishes the fact that the latter belongs to the secondary groupe of rocks.

The examination of the numerous vegetable impressions which occur in the sand stone, throw some doubt upon this hypothesis, there being, in most of these plants, a perfect analogy of character with those from the sand stone which accompanies bituminous coal, whilst they have nothing in common with the lias.

Either hypothesis would conflict with the received ideas in relation to the distribution of fossil plants and shells in the geological formations.

The anthracite sand stone varies much in colour; its grain is usually large; it contains some particles of mica; as it approaches the coal, it becomes slaty, its grain is finer, and it is of a deep gray colour; vegetable impressions, and iron pyrites, abound in it. The anthracite is sometimes solid, sometimes friable; but it is remarkable that the two varieties have never been found united in the same bed.

In general, the thickest beds, varying from five and a half to twenty-one yards, give a compact variety, which is the only one that has been used at Vizille. This variety is of a perfect black; its lustre, slightly metallic, is greater than that of bituminous coal. Sometimes it is irised; the fracture is conchoidal, when it is made in the mass; at other times, it is lamellar, following the little strata of schistus which traverse it, as in the bituminous coal.

The anthracite, in breaking, follows small white veins, principally calcareous, which traverse it in different directions, and which fill the fissures, which were, doubtless, formed in the coal by fire. It is also according to these veins that the anthracite breaks up, when stored, causing a very considerable loss.

Its density is very great; the cubic foot, such as passed to the furnace, weighed fifty one and a half pounds, (not picked, its weight was sixty-seven pounds,) whilst the weight of coke of the Rive-de-Gier, is from $20\frac{1}{2}$ to $23\frac{1}{3}$ pounds, only, and that of charcoal varies from $9\frac{1}{2}$ to 13 pounds.

By reason of its great compactness, the anthracite kindles with difficulty, and consumes slowly. On the fire, it possesses a property that no other coal possesses; it is reduced into fragments, of which the size is usually regulated by the small veins before mentioned. It would appear that the expansion of the vaporized water has less to do with this phenomenon than the dilatation of this dense matter; for the same thing takes place with well dried coal, and if the heat is so strong that the masses do not become gradually hot, they fall into small pieces, like those from a mass of cold glass, under the same circumstances. To these properties of anthracite, namely, that of burning slowly, and of dividing itself in the fire, are to be attributed the little success which attended the experiment at Vizille.

Another defect of this coal, though less prejudicial than the preceding, is the quantity of pyrites it contains, often visible to the eye;

it is generally spread through all the grand divisions of the mass, and disengages, when burning, a very marked odour, which denotes its presence. The anthracite burns with a feeble, blueish flame, and does not give off the least smoke. Submitted to calcination, its loss, which is almost insensible, may be attributed to a little moisture, and carbonic acid, corresponding to the carbonate of lime contained in its ashes; it contains no bitumen. When it is of good quality, its residuum by incineration is less than four per cent.; in other cases, it rarely exceeds ten per cent. In respect to its purity, this combustible, therefore, leaves little to desire, for the cokes of Loire give eight, and even fourteen per cent. of ashes.

The ashes of anthracite* give the following constituents, the analysis being a mean of experiments on a large quantity.

Silex, . . .	58.4
Alumine, and oxide of iron,	40.
Lime, . . .	1.6
	100.0

Those of the coke from Rive-de-Gier, employed at Vizille, contain:

Silex, . . .	57.8
Alumine, and oxide of iron,	34.4
Lime, . . .	7.2
	99.4

Before it was sent to the furnace, the anthracite was carefully picked, and broken in pieces the size of the fist; the slate, and also the pieces of coal which were less than a walnut in size, being rejected. This selection produced an enormous loss; thus the provision for one year gave the following results, from 414,812 kilograms.

Coal for the furnace, large pieces,	210,672 kilogs.	50.8 per cent.
Small coal, . .	74,973	18.1
Dust, . . .	117,267	28.2
Slate, . . .	11,900	2.9
	414,812	100

The loss on coals freshly mined was not so great, the mean of three trials having given,—

* The mean of several analysis of the ashes of the Tamaqua Anthracite gave Profs. Rogers and Bache,

Silica	47
Alumina	36
Oxide of Iron	14.5
Lime	1.5
Magnesia	1.0

being eleven per cent. less of silica, and ten per cent. more of alumina and iron, together, than in the anthracite under discussion.

[*See Journ. Acad. Nat. Sci. Vol.* vii. *Part* 1.

Coal fit for the furnace,	60.8
Small coal,	9.1
Dust,	26.9
Slate,	3.2
	100.0

If the establishment had prospered, the small coal would have been used advantageously in the puddling furnaces, as may be seen in a note upon the refining of iron by means of anthracite, (Annales des Mines, No. 4, 1829;) but the major part of the dust gives a real loss, since it can only be used in small quantities, to roast the ore, and calcine limestone, or plaster.

Minerals.

It would be superfluous to mention all the minerals which have been discovered in the numerous veins and beds in the trap formation, which breaks out at Vizille, and extends over a great part of the Alps. It will suffice to say a few words in relation to the minerals which have been principally employed in these trials.

Two different varieties of ores are distinguished by their properties, as well as by their richness; some are magnesian, others contain lime, in addition. These last would be too poor to be worth working, if, on account of the low price at which they are obtained, and of their composition, they were not found useful as good fluxes. For want of it, they employed a flux obtained from the lias limestone, in another quarry, near which smelting furnaces had been constructed.

Two analysises of each of these kinds of ore, have given the following results.

Iron Ore of Pierre-plate.		*Iron Ore of Halles.*	
Quartz,	2.60	Quartz,	4.20
Carbonate of iron,	82.80	Carbonate of iron,	67.67
Carbonate of manganese,	3.40	Carbonate of manganese,	1.16
Carbonate of magnesia,	11.20	Carbonate of magnesia,	24.78
		Pyrites,	1.64
	100.0		99.45

Ore from the great vein.		*Ore of Cauriglion.*	
Quartz,	1.08	Quartz,	4.20
Carbonate of iron,	26.16	Carbonate of iron,	24.51
Carbonate of manganese,	0.85	Carbonate of manganese,	1.20
Carbonate of magnesia,	23.14	Carbonate of magnesia,	20.65
Carbonate of lime,	48.23	Carbonate of lime,	48.24
	99.46		98.80

The foundry of Vizille has been sometimes worked with the veins of decomposed carbonate of iron.

The smelting of this mineral is analogous to that of a roasted ore, which has been exposed to the air for a long time. Worked on a large scale, the rich ore will have fifteen to twenty per cent. of gangue; the other much less. During the roasting to which it is usually submitted, the first loses from 15 to 18 per cent. in carbonic acid alone; it then yields from 38 to 42 per cent. in the furnace. But this operation, which was at first practised at Vizille, has been abandoned, because the ore is reduced to powder by cooling, when taken from the roasting kiln. The furnace being charged with ore, and with anthracite, which also falls to fine dust, the passage of air through the mass becomes almost impossible.

The ore for charging was there used in the crude state, but reduced to fragments a little smaller than the coal.

The question whether the carbonate of iron, of which the reduction is in general so easy, presented difficulties in working with anthracite, had also excited the attention of metallurgists. It has been favourably answered; this variety of ore leaving nothing to desire on this head.

Furnace.

The furnace constructed to make the trials, was the same as the coke furnace, and its dimensions moderate.

The whole height, from the bosh to the trunnel-head, was 13 metres, (43.4 feet.)

The hearth was 2.25 m. (7.6 feet) high, 0.65 m. (2.1 ft.) wide, and 0.70 (2.4 feet) long.

The furnace was conical, and from the hearth to the beginning of the boshes was 1.80 m. (6 feet) in height; near the hearth, its diameter was 0.65 m., (2.6 inches;) at the boshes, 1.2 m., (4 feet.)

The boshes were in the form of an eight-sided pyramid, were 1.5 m. (5 feet) high, and at their junction with the furnace above the breadth, were 3.15 m., (10.5 feet.)

The height from the hearth to the head of the bosh, amounted to 4 m., (13⅓ feet,) and from this position to the trunnel-head, 7 m., (23½ feet.) The diameter of the latter was 1.2 m., (4 feet,) and it was surmounted by a chimney, 4.25 m., (14.2 feet.)

The interior of the furnace was entirely constructed of fire brick, of Bollene clay, mixed with silicious sand.

Of the three tuyeres, two were placed upon the sides, the other a little higher, opposite the tymp, facilitating the variation of the blast at pleasure.

Bellows.

A blowing machine, of eighty horse power, gave ample and perfectly regular blasts. The blast furnace was put in operation, for the first time, on the 13th of April, 1827. It was natural to suppose that, with a new material, unforeseen difficulties

would arise. To avoid them as much as possible, and to encounter them by degrees, fire was made, in the first place, with coke of Rive-de-Gier, to which the anthracite was added successively by tenths. No accident happened with the use of coke alone, but the carbonate of iron gave metal of excellent quality.

The first three tenths of anthracite passed without trouble, but during the addition of the following two tenths, the working met with frequent derangements, which were attributed, in part, to the tenuity of the ore which was roasted, and also to that of the anthracite, but more especially to the delays occasioned by accidents to the blowing machine. The last rupture in the blowing apparatus compelled them to allow the fire to go out, on the 21st of June, after seventy days work.

(*To be continued.*)

REPORT

To the Board of Directors of Bridges, Public Roads, and Mines, upon the Use of Heated Air in the Iron Works of Scotland and England. By M. Dufrenoy, *Engineer of Mines. Paris*, 1834.

[Translated for this Journal, by S. V. Merrick.]

Continued from p. 220.

ENVIRONS OF DERBY.

The coal basin of Derby, a prolongation of that of Sheffield, contains many large iron works; three of them, the Butterly, Codnor Park, and Alpdon works, have adopted the hot air blast. I visited the first two, under the charge of Mr. Jessop, one of the most intelligent iron masters in the kingdom. The heating apparatus of all these differ from those I have described, and, in some essential respects, from each other. For this reason, I have deemed it proper to describe them in detail, though the results which they give are not so favourable as those obtained at the Calder works.

Butterly Iron Works contains three smelting furnaces. The iron there made is intended for castings, either of first or second runnings. One furnace only was in blast when I visited Derbyshire. The air for the blast was heated by an apparatus at each tuyere; this apparatus, plate 3, figs. 11 and 12, was composed of the large pipes, A B C, twenty-seven inches diameter in the clear, placed horizontally one over the other, and separated by arched plates, *m n*, *m' n'*. These pipes are connected in pairs, by elbow pipes, *d e*, *d' e'*. The air from the blast engine enters by the pipe *c*, and makes its exit at *g*, after having passed the length of the three pipes successively. The joints are placed on the outside of the furnace proper; but to prevent the air being cooled in traversing the elbows, they are cased in brick-work.

The elbows connecting the long pipes are in plates, connected by bolts and nuts, passing through lugs, or flanges. The pipes are one

and a half inches thick, and rest upon fire lumps, *t t*, placed at proper distances upon the arch plates, *m n*, *m' n'*. This disposition allows the flame to envelop them on all sides.

The first pipe, A, is not exposed directly to the action of the fire; it is separated from the grate by an arch of brick, extending the whole length of the furnace, which allows the flame to pass by the flues, *v v*. The partitions, *m* and *n*, have openings, *p* and *q*, placed at the opposite ends of the furnace, so as to compel the flame to traverse the whole length, without escaping from one story to another. All the arches are of fire brick, one brick thick. The expenditure of this apparatus is 62 cwt. for each ton of casting made. The air is raised to 360° Fahr. Notwithstanding the feeble temperature, a great economy of fuel is effected, as indicated below.

Consumption and Products during the first week in July, 1830, *from furnace No. 2, worked with cold air.*

159 tons 5 cwt. of coke, corresponding to

tons.	*cwt.*	
218	10	of coal,
109	17	of ore,
35		of flux,

Produced 83 tons of metal.

Consumption and Products of furnace No. 2, on the 17th of July, 1833; *heated air being used.*

The furnace received forty-one charges, each composed of—

9 cwt. crude coal,
9 " ore roasted,
3 " flux.

The average of the first fortnight in July had been forty charges per day, and the iron produced seven tons.

Upon comparing, from these data, the consumption of the two periods, one ton of iron required as follows:

1830. *Cold Air and Coke.*		1833. *Heated Air and Coal.*	
Coal,	5 tons 16 cwt.	Coal,	2 tons 18 cwt. incl'g fuel
Ore,	3 "	Ore,	2 11 [to heat the air
Flux,	1 "	Flux,	1 "

To know the whole expense of fuel, that used by the blast engine must be added, for which I have no precise data; but this expense must necessarily diminish in proportion to the increased yield of the furnace.

At Butterly, therefore, a saving of one-half the fuel has been effected by the introduction of the new plan. The quantity of flux

remains the same, because the sulphurous nature of the coal requires a large proportion of lime.

The blast engine, which served but two furnaces, now works three; but to obtain this increase, a larger cylinder was put in. Formerly, the cylinder was seventy inches in diameter, and eight feet stroke, working thirteen revolutions; now, the cylinder is eighty inches, the length of stroke, and number of revolutions, remaining the same.

The quantity of air expended, which was 2,500 cubic feet per minute, is now reduced to 2,160 feet; but the pressure, two and a half pounds to the inch, has undergone no variation. The opening at the mouth of the tuyere has been reduced from two and a half to three inches; the iron produced is intended for castings.

Codnor Park Works.—This work consists of three furnaces, three refineries, and a sufficient number of puddling furnaces to work up all the metal. These furnaces have worked for the past year with heated air, and crude coal. The substitution of heated air has produced a saving of fuel similar to that stated for Butterly; 2 tons 9 cwt. being now sufficient to obtain one ton of metal, which formerly required five tons. It should be remarked, that the expense of coal has always been less at Codnor Park than at Butterly, on account of the difference in the quality of iron produced. This difference would be much more sensible, if the same quality of coal was used at both works; but at Codnor Park the soft coal is used, while at the other a variety called cherry coal is used, which better resists the action of the blast.

Consumption for one ton, using Cold Blast.

Butterly, . .	5 tons 16 cwt.
Codnor Park, . .	5 "

Same with Hot Air.

	Butterly.	Codnor Park.
For smelting,	2 tons 12 cwt.	2 tons 9 cwt.
" apparatus,	6	6
Total,	2 tons 18 cwt.	2 tons 15 cwt.

The apparatus employed at Codnor Park, for heating the blast, is composed of two pipes, A and B, plate 3, figs. 13 and 14, placed one above the other, in which are inserted small pipes, *a b*, having the same centres as the large pipes, A and B. These pipes are connected by elbows, so that the air, in passing from the blast engine, through the interior pipe, *b*, spreads itself over the circular space, *c d*, between the pipes B and *b;* passing then into the second interior pipe, *a*, is transmitted to the furnace by traversing the second circular space, A.

This disposition of double pipes, one within the other, was adopted

to remedy a serious inconvenience experienced at Butterly,—an inconvenience incident to pipes of large diameter, in which the air being heated unequally, a current of cool air passes along the centre of the pipe, and renders it impossible to raise the temperature sufficiently.

The pipes, A B, are of cast-iron, thirty inches diameter outside, and one and a half inches thick; the small pipes, *a* and *b*, are of boiler iron, six-tenths of an inch thick, and eighteen inches diameter in the clear. The construction of the furnace is the same as at Butterly, figs. 13 and 14 giving an exact idea of it. The air is heated, by means of this apparatus, to 400° Fahr., with a consumption of 6 cwt. coal.

We have already stated that all the metal made at Codnor Park is made into malleable iron;* this iron is used in the machine shops of Mr. Jessop. It serves equally well for boiler iron for steam engines, a use which requires the very best metal.

Environs of Birmingham.

The introduction of the hot air blast has scarcely commenced in the Staffordshire iron district, the opinion being still prevalent that the quality of the iron is deteriorated by its use, has retarded the trial of it until within a year past. One work only, near Wednesbury, belonging to Messrs. Lloyd, Forster & Co., uses the heated air. The success attending this experiment determined the proprietors of the other works to make similar trials.

The apparatus employed here is placed above the trunnel head of the furnace, and is the only one at which such an arrangement has been effected in England. It is composed of a solid pyramidal ring, (plate 3, figs. 15 and 16,) A B C D, and a series of small tubes, *t*, which penetrate into the furnace.

The interior surface of the ring, *a b c d*, is a cast iron cylinder, four feet in diameter, and twelve feet in height, in place of the chimney which usually surmounts the trunnel head of the furnace. The exterior surface of the pyramid is octagonal, and made of boiler plates, riveted together, like a steam boiler, its diameter at the middle being six feet; a space is left between the surfaces, of one foot on all sides; to protect the outer surface from the cooling action of the air, it is encased in brick-work.

The air passing from the blast engine, is carried to the top of the furnace, circulates through the pipe, *e e e*, on a level with the top of the furnace, then divides itself among the eight vertical pipes, *f g*, placed round the outer surface of the casing, which are connected with the circular pipe; each of these vertical tubes communicates with the interior of the case, or pyramid, by six small tubes, which pass into projections within the interior of the furnace.

This part of the tubes, *t*, enters into the pipes, *t'*, closed at the

* This is an error, as large quantities of pipes are cast at this work for the London market.—*Trans.*

the transition rocks, contains the fossils which are characteristic of the lias formation. The alternation of this limestone with the sand stone, establishes the fact that the latter belongs to the secondary groupe of rocks.

The examination of the numerous vegetable impressions which occur in the sand stone, throw some doubt upon this hypothesis, there being, in most of these plants, a perfect analogy of character with those from the sand stone which accompanies bituminous coal, whilst they have nothing in common with the lias.

Either hypothesis would conflict with the received ideas in relation to the distribution of fossil plants and shells in the geological formations.

The anthracite sand stone varies much in colour; its grain is usually large; it contains some particles of mica; as it approaches the coal, it becomes slaty, its grain is finer, and it is of a deep gray colour; vegetable impressions, and iron pyrites, abound in it. The anthracite is sometimes solid, sometimes friable; but it is remarkable that the two varieties have never been found united in the same bed.

In general, the thickest beds, varying from five and a half to twenty-one yards, give a compact variety, which is the only one that has been used at Vizille. This variety is of a perfect black; its lustre, slightly metallic, is greater than that of bituminous coal. Sometimes it is irised; the fracture is conchoidal, when it is made in the mass; at other times, it is lamellar, following the little strata of schistus which traverse it, as in the bituminous coal.

The anthracite, in breaking, follows small white veins, principally calcareous, which traverse it in different directions, and which fill the fissures, which were, doubtless, formed in the coal by fire. It is also according to these veins that the anthracite breaks up, when stored, causing a very considerable loss.

Its density is very great; the cubic foot, such as passed to the furnace, weighed fifty-one and a half pounds, (not picked, its weight was sixty-seven pounds,) whilst the weight of coke of the Rive-de-Gier, is from $20\frac{1}{2}$ to $23\frac{1}{3}$ pounds, only, and that of charcoal varies from $9\frac{1}{2}$ to 13 pounds.

By reason of its great compactness, the anthracite kindles with difficulty, and consumes slowly. On the fire, it possesses a property that no other coal possesses; it is reduced into fragments, of which the size is usually regulated by the small veins before mentioned. It would appear that the expansion of the vaporized water has less to do with this phenomenon than the dilatation of this dense matter; for the same thing takes place with well dried coal, and if the heat is so strong that the masses do not become gradually hot, they fall into small pieces, like those from a mass of cold glass, under the same circumstances. To these properties of anthracite, namely, that of burning slowly, and of dividing itself in the fire, are to be attributed the little success which attended the experiment at Vizille.

Another defect of this coal, though less prejudicial than the preceding, is the quantity of pyrites it contains, often visible to the eye;

it is generally spread through all the grand divisions of the mass, and disengages, when burning, a very marked odour, which denotes its presence. The anthracite burns with a feeble, blueish flame, and does not give off the least smoke. Submitted to calcination, its loss, which is almost insensible, may be attributed to a little moisture, and carbonic acid, corresponding to the carbonate of lime contained in its ashes; it contains no bitumen. When it is of good quality, its residuum by incineration is less than four per cent.; in other cases, it rarely exceeds ten per cent. In respect to its purity, this combustible, therefore, leaves little to desire, for the cokes of Loire give eight, and even fourteen per cent. of ashes.

The ashes of anthracite* give the following constituents, the analysis being a mean of experiments on a large quantity.

Silex, . . .	58.4
Alumine, and oxide of iron,	40.
Lime, . . .	1.6
	100.0

Those of the coke from Rive-de-Gier, employed at Vizille, contain:

Silex, . . .	57.8
Alumine, and oxide of iron,	34.4
Lime, . . .	7.2
	99.4

Before it was sent to the furnace, the anthracite was carefully picked, and broken in pieces the size of the fist; the slate, and also the pieces of coal which were less than a walnut in size, being rejected. This selection produced an enormous loss; thus the provision for one year gave the following results, from 414,812 kilograms.

Coal for the furnace, large pieces,	210,672 kilogs.	50.8 per cent.
Small coal, . .	74,973	18.1
Dust, . . .	117,267	28.2
Slate, . . .	11,900	2.9
	414,812	100

The loss on coals freshly mined was not so great, the mean of three trials having given,—

* The mean of several analysis of the ashes of the Tamaqua Anthracite gave Profs. Rogers and Bache,

Silica	47
Alumina	36
Oxide of Iron	14.5
Lime	1.5
Magnesia	1.0

being eleven per cent. less of silica, and ten per cent. more of alumina and iron, together, than in the anthracite under discussion.

[*See Journ. Acad. Nat. Sci. Vol.* vii. *Part* 1.

Coal fit for the furnace,	60.8
Small coal,	9.1
Dust,	26.9
Slate,	3.2
	100.0

If the establishment had prospered, the small coal would have been used advantageously in the puddling furnaces, as may be seen in a note upon the refining of iron by means of anthracite, (Annales des Mines, No. 4, 1829;) but the major part of the dust gives a real loss, since it can only be used in small quantities, to roast the ore, and calcine limestone, or plaster.

Minerals.

It would be superfluous to mention all the minerals which have been discovered in the numerous veins and beds in the trap formation, which breaks out at Vizille, and extends over a great part of the Alps. It will suffice to say a few words in relation to the minerals which have been principally employed in these trials.

Two different varieties of ores are distinguished by their properties, as well as by their richness; some are magnesian, others contain lime, in addition. These last would be too poor to be worth working, if, on account of the low price at which they are obtained, and of their composition, they were not found useful as good fluxes. For want of it, they employed a flux obtained from the lias limestone, in another quarry, near which smelting furnaces had been constructed.

Two analysises of each of these kinds of ore, have given the following results.

Iron Ore of Pierre-plate.		*Iron Ore of Halles.*	
Quartz,	2.60	Quartz,	4.20
Carbonate of iron,	82.80	Carbonate of iron,	67.67
Carbonate of manganese,	3.40	Carbonate of manganese,	1.16
Carbonate of magnesia,	11.20	Carbonate of magnesia,	24.78
		Pyrites,	1.64
	100.0		99.45

Ore from the great vein.		*Ore of Cauriglion.*	
Quartz,	1.08	Quartz,	4.20
Carbonate of iron,	26.16	Carbonate of iron,	24.51
Carbonate of manganese,	0.85	Carbonate of manganese,	1.20
Carbonate of magnesia,	23.14	Carbonate of magnesia,	20.65
Carbonate of lime,	48.23	Carbonate of lime,	48.24
	99.46		98.80

The foundry of Vizille has been sometimes worked with the veins of decomposed carbonate of iron.

The smelting of this mineral is analogous to that of a roasted ore, which has been exposed to the air for a long time. Worked on a large scale, the rich ore will have fifteen to twenty per cent. of gangue; the other much less. During the roasting to which it is usually submitted, the first loses from 15 to 18 per cent. in carbonic acid alone; it then yields from 38 to 42 per cent. in the furnace. But this operation, which was at first practised at Vizille, has been abandoned, because the ore is reduced to powder by cooling, when taken from the roasting kiln. The furnace being charged with ore, and with anthracite, which also falls to fine dust, the passage of air through the mass becomes almost impossible.

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The boshes were in the form of an eight-sided pyramid, were 1.5 m. (5 feet) high, and at their junction with the furnace above the breadth, were 3.15 m., (10.5 feet.)

The height from the hearth to the head of the bosh, amounted to 4 m., (13½ feet.) and from this position to the trunnel-head, 7 m., (23½ feet.) The diameter of the latter was 1.2 m., (4 feet,) and it was surmounted by a chimney, 4.25 m., (14.2 feet.)

The interior of the furnace was entirely constructed of fire brick, of Bollene clay, mixed with silicious sand.

Of the three tuyeres, two were placed upon the sides, the other a little higher, opposite the tymp, facilitating the variation of the blast at pleasure.

Bellows.

A blowing machine, of eighty horse power, gave ample and perfectly regular blasts. The blast furnace was put in operation, for the first time, on the 13th of April, 1827. It was natural to suppose that, with a new material, unforeseen difficulties

would arise. To avoid them as much as possible, and to encounter them by degrees, fire was made, in the first place, with coke of Rive-de-Gier, to which the anthracite was added successively by tenths. No accident happened with the use of coke alone, but the carbonate of iron gave metal of excellent quality.

The first three tenths of anthracite passed without trouble, but during the addition of the following two tenths, the working met with frequent derangements, which were attributed, in part, to the tenuity of the ore which was roasted, and also to that of the anthracite, but more especially to the delays occasioned by accidents to the blowing machine. The last rupture in the blowing apparatus compelled them to allow the fire to go out, on the 21st of June, after seventy days work.

(*To be continued.*)

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Continued from p. 220.

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and a half inches thick, and rest upon fire lumps, *t t*, placed at proper distances upon the arch plates, *m n*, *m' n'*. This disposition allows the flame to envelop them on all sides.

The first pipe, A, is not exposed directly to the action of the fire; it is separated from the grate by an arch of brick, extending the whole length of the furnace, which allows the flame to pass by the flues, *v v*. The partitions, *m* and *n*, have openings, *p* and *q*, placed at the opposite ends of the furnace, so as to compel the flame to traverse the whole length, without escaping from one story to another. All the arches are of fire brick, one brick thick. The expenditure of this apparatus is 62 cwt. for each ton of casting made. The air is raised to 360° Fahr. Notwithstanding the feeble temperature, a great economy of fuel is effected, as indicated below.

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tons.	*cwt.*	
218	10	of coal,
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35		of flux,

Produced 83 tons of metal.

Consumption and Products of furnace No. 2, on the 17th of July, 1833; *heated air being used.*

The furnace received forty-one charges, each composed of—

9 cwt. crude coal,
9 " ore roasted,
3 " flux.

The average of the first fortnight in July had been forty charges per day, and the iron produced seven tons.

Upon comparing, from these data, the consumption of the two periods, one ton of iron required as follows:

1830. *Cold Air and Coke.*			1833. *Heated Air and Coal.*		
Coal,	5 tons	16 cwt.	Coal,	2 tons	18 cwt. incl'g fuel
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To know the whole expense of fuel, that used by the blast engine must be added, for which I have no precise data; but this expense must necessarily diminish in proportion to the increased yield of the furnace.

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The introduction of the hot air blast has scarcely commenced in the Staffordshire iron district, the opinion being still prevalent that the quality of the iron is deteriorated by its use, has retarded the trial of it until within a year past. One work only, near Wednesbury, belonging to Messrs. Lloyd, Forster & Co., uses the heated air. The success attending this experiment determined the proprietors of the other works to make similar trials.

The apparatus employed here is placed above the trunnel head of the furnace, and is the only one at which such an arrangement has been effected in England. It is composed of a solid pyramidal ring, (plate 3, figs. 15 and 16,) A B C D, and a series of small tubes, *t*, which penetrate into the furnace.

The interior surface of the ring, *a b c d*, is a cast iron cylinder, four feet in diameter, and twelve feet in height, in place of the chimney which usually surmounts the trunnel head of the furnace. The exterior surface of the pyramid is octagonal, and made of boiler plates, riveted together, like a steam boiler, its diameter at the middle being six feet; a space is left between the surfaces, of one foot on all sides; to protect the outer surface from the cooling action of the air, it is encased in brick-work.

The air passing from the blast engine, is carried to the top of the furnace, circulates through the pipe, *e e e*, on a level with the top of the furnace, then divides itself among the eight vertical pipes, *f g*, placed round the outer surface of the casing, which are connected with the circular pipe; each of these vertical tubes communicates with the interior of the case, or pyramid, by six small tubes, which pass into projections within the interior of the furnace.

This part of the tubes, *t*, enters into the pipes, *t'*, closed at the

* This is an error, as large quantities of pipes are cast at this work for the London market.—*Trans.*

extremity; so that the air, in moving, is forced to spread itself over the surface of the heater. These tubes, *t'*, are all of cast iron, and are connected with the distributing pipes, *f g*, by leather sleeves, *t''*.

The air, after being heated in the tubes, *t'*, and in the circular heater, A B C D, *a b c d*, reascends to the tuyeres by the opening, *v*. To prevent the air from cooling during the transit, the conductor is placed in the chimney of the steam boiler, twelve or fifteen feet distant; a kind of brick-work connects the furnace with this chimney.

With all these precautions, the temperature of the blast cannot be raised higher than to 360° Fahr., and they are obliged to heat it again in a furnace, within a few feet of the embrasure of the furnace.

The consumption of this fire is nearly 4 cwt. of coal to the ton of iron.

This apparatus is very costly, and requires frequent repairs; the little saving of fuel effected by it, (about 3 cwt. of coal per ton of iron,) is more than compensated for by the expense of construction and repairs, and, above all, by the numerous interruptions which take place in consequence of repairs required almost daily.

The introduction of hot air has effected, in these works, the same economy as in the others cited, where this plan is adopted. One ton of iron required, in 1831, 3 tons of coke, equal to 5 tons 9 cwt. of coal; now, the same quantity of iron consumes 2 tons 14 cwt. of coal, as the following statement shows.

On the 20th of July, there passed through the furnace, twenty charges, composed of—

10 cwt. crude coal,
9 " roasted ore,
6 " flux.

The product being eight tons of metal, each ton consumed—

	t.	*cwt.*		
Coal for fusion,	2	10		
" for heating the apparatus,		4	*t.*	*cwt.*
			2	14
Ore roasted,			2	5
Flux,			1	10

The consumption in flux was considerable, because of the sulphurous nature of the ore. The slag which came from the furnace was crystalline, and gave off very strong sulphurous odours. Before the introduction of hot air, the daily production of the furnace was only six tons. They have, therefore, obtained, besides an economy in fuel, a diminution of the general expenses, and of labour. The quantity of blast has not been changed, but the tuyeres have been enlarged from two inches nine lines, to three inches six lines.

Part of the iron produced at the works of Mr. Forster, is used for the foundry, and part for fine metal; the same running gives both kinds of iron; that which flows first from the hearth, is No. 1 pig metal; the last running gives No. 2. They distinguish the two kinds of iron by the manner in which they run from the furnace, and by the furrows produced on the surface, when it cools.

Wales.

There are in Wales but two works using the heated air—that of *Warteg*, and *Blaen-Avon*, ten miles from *Abergaveny*. None of the *Merthyr-tidvyl* works have introduced it, though the *Dowlais* and *Penn-y-danau* have made experiments thereon.

The abandonment of heated air in so extensive an iron country, and in which improvements are sought after with care, has led many to doubt the reality of the advantages claimed for it. Some have thought that, while so much saving was effected by the use of this plan in the furnaces of Scotland, where the metal was destined for the foundry, it could not be employed by other works, the product of which is converted into bar, or malleable, iron.

The examples furnished by the *Newcastle*, *Codnor Park*, and *Wednesbury* works, in which they make bar iron of very good quality, prove that this opinion is not well founded. The partial abandonment of the plan in Wales, should, in part, be attributed to the bad construction of their heating apparatus, but more especially to the diminished saving which would result to them, since the employment of crude coal has been effected; a saving which the cost of the patent would almost balance. To appreciate these reasons, it is necessary to enter into some details upon the expense of making iron in that country.

From all the information gained upon the experiments made at Dowlais, or Penn-y-danau, it appears that, the apparatus being of bad construction, the temperature of the air could not be raised to more than 300° Fahr. Notwithstanding this, they attempted, with success, the substitution of crude coal for coke. An accident happening to the apparatus, obliged them to suspend the use of hot air for several days, and showed them that, without difficulty, the crude coal could be worked even with cold air. The saving which resulted from this substitution was such, that the proprietors did not deem it worth while to repair the heating apparatus, and thenceforth abandoned it. Since that period, most of the Welsh furnaces use the crude coal, but some employ a mixture of coal and coke.

The following table shows the quantity of fuel and material required to produce one ton of metal.

Penn-y-danau.				*Dowlais.*			*Cyfartha.*			*Plymouth.*		
	t.	*c.*	*q.*	*t.*	*c.*	*q.*	*t.*	*c.*	*q.*	*t.*	*c.*	*q.*
Coal,	2	9	0	2	14	0	2	13	2	2	13	0
Ore roasted,	2	4	0	2	9	0	2	6	2	1	16	0
Ashes,		2	2									
Flux,		19	2	0	13	0		16				

Add to this, the quantity consumed by the blast engines, about the same for each, varying from 5 to 6 cwt.

The average quantity of coal consumed in each of these works, is,

therefore, two and a half tons for each ton of iron. By the employment of heated air, it is not probable that a saving would be effected over this expense, of more than 33½ per cent., or 17 cwt. of coal for each ton of iron; deduct from this, the fuel consumed to heat the apparatus, estimated at 6 cwt., and the actual saving would be reduced to 11 cwt., costing, at 3*s.* 7*d.*, or 86 cents per ton, at the works, 44 cents; and as the patent right is charged at one-half, or 24 cents per ton of iron, the saving would be diminished to 20 cents per ton. This economy, itself very small, would scarcely be appreciated in a district where all the materials are so cheap, that iron may be produced at a less price than in any other district in Great Britain.

I believe, therefore, that the non-adoption of this plan in Wales, is no evidence that it does not effect any saving in fuel; but, on the contrary, it leads me to think that there would be economy, as in other works where the plan is used; but it is evident that, the expense* of coal being very small in Wales, the economy would not be as marked as in the works of Scotland.

The *Warteg Iron Works*, which have been named at the beginning of this section, sustain this opinion. In this establishment, the heating apparatus is composed of a very short development of pipes, so that the air cannot acquire a temperature of more than 400° Fah. The coal, which is very bituminous, and loses 55° per 100 in the coking, cannot be employed crude in the furnace, with the air at so low a temperature; it results from these circumstances, that the saving obtained is not so great as at the furnaces of Scotland, but is to be compared to the saving in those works where the apparatus is not so perfect, and where coke is still used. Nevertheless, the diminution in the cost is very marked; before the introduction of heated air, one ton of iron required a consumption of two tons of coke; the produce of four tons, three cwt. of coal. The consumption of coke is still about the same, but, as there is no necessity for carbonizing it so completely, it is now produced by only three tons of coal.

The yield of the furnace has been augmented from six to eight tons of iron, each, in twenty-four hours.

[TO BE CONTINUED.]

¶ *Notice regarding a Series of Experiments made on the Forth and Clyde Canal, with the view of ascertaining the comparative Resistance of certain Forms of Vessels when tracked at varied Velocities.*

In the way in which experiments to ascertain the forms of least resistance of floating bodies have generally been made, so costly an apparatus, and so much precision and skill in observation, have been

* The author should have attributed this difference, in a great degree, to the superior quality of the Taff Vale coal over the Scotch, the former yielding more than 75 per cent. of carbon, while the proportion in the latter is less than 65 per cent.; some varieties even as little as 51 per cent.—[*Trans.*

required in order to give any value to the results, that comparatively few persons have been enabled to undertake such investigations, notwithstanding the obvious advantage to be derived by those interested in canal navigation, from an accurate knowledge of the forms most suitable for vessels, according to the circumstances under which they are to be employed.

The great increase of speed which has lately been effected in railway carriage, having made it expedient that corresponding improvements should be introduced into the transport of goods on canals, and it became the interest of canal proprietors to use active endeavours for this purpose. The directors of the Forth and Clyde Canal have shown themselves particularly well disposed to encourage such investigations, and have applied a considerable portion of their revenue to the construction of experimental steam vessels, and to the improvement of the facings of the canal, so as to admit of the transit of large vessels at rates of speed, which, until lately, have been supposed impracticable in confined water.

In order to obtain a maximum of effect from the power employed in such steam vessels, it was necessary to ascertain as nearly as possible the form which should be given to their bodies; and as much diversity of opinion existed on this point, I ventured to suggest to the directors that experiments should be made on the canal with models of a sufficient size to admit of safe conclusions being drawn from the results of the trials.

In consequence of this suggestion, four models were prepared, of the following dimensions:—

No. 1 was 8 ft. 3 in. long, 2 ft. wide, 1 ft. deep;
No. 2 was 8 ft. 3 in. long, 2 ft. wide, and 1 ft. 6 in. deep;
No. 3 was 8 ft. 3 in. long, 2 ft. wide, and 1 ft. 6 in. deep;
No. 4 was 9 ft. 1 in. each part, 1 ft. wide, and 1 ft. deep;
And the weight of each, 187½ lbs.

No. 1 was quite flat on the floor, rounded at the bilges, and perpendicular in the sides at the midship section, but with a fine entrance and run.

No. 2 was made in the proportions of an ordinary coasting trader.

No. 3 in the proportions of a sharp-built schooner.

No. 4 was a twin boat, similar in its sections to No. 1, only that the breadth of each portion was half of the other breadth, while the depth was the same.

The weight of all the models being alike, their displacement of water was equal, although their draft, or depth of immersion, was necessarily different.

The usual way of trying the resistance of floating bodies, is by drawing them across a dock, or basin, by a cord running over delicately hung pulleys on a high mast, and with certain weights attached: the time is accurately noted which each form requires to move through a certain space, and the comparative resistances are calculated from these elements. This method presents many difficulties and disadvantages; and I therefore resolved on adopting a different one, which should admit of each experiment being carried

on through a much greater space than can be accomplished by means of cords and pulleys. My first intention was to tow each model by a long slender line from the after part of a light steamboat, which was capable of running about seven miles per hour in the canal. This line was to have been attached to an hydrostatic dynamometer, and by this means, the strain exerted on the towing line at every different rate of speed by each of the models *in succession*, might have been approximated. I was enabled, however, by a suggestion from an ingenious friend, (Mr. Oldham, of the Bank of Ireland,) to adopt a much more summary and satisfactory way of determining the comparative resistances of the different models; and as it was the *comparative* resistance alone which required investigation, there could be no inducement to go through the more tedious process of trying the resistances separately, and of incurring the risk of error from mistakes in reading off the indications of the dynamometer.

I prepared accordingly, a spar, or yoke, of sixteen feet eight inches long, which was divided into one hundred parts of two inches each; a small eye bolt was fixed at each extremity, and a shifting hasp fitted to the middle part. With this yoke all the experiments were made by the two following processes:—First, a model was attached by a slender towing line to each eye bolt, and the hasp was fixed exactly in the middle of the yoke, and linked to an outrigger on the steam vessel, which was then set in motion at the required speed. If it was found that one of the models preceded the other, in consequence of its offering less resistance, the hasp was shifted along the spar towards the sluggish one, until the resistances were balanced, and the two models ran abreast of one another. The relative lengths of the arms of the yoke then gave an inverse measure of the comparative resistances of the models, *at that* rate of speed; this being noted down, the hasp was brought again to the middle of the yoke, and the model which showed least resistance, was by degrees loaded with weights, until it again exactly balanced the other, and swam abreast of it, the amount of the added weights being likewise noted, afforded a second measure of the difference of the resistance of the two models.

Each of these forms of the experiment was gone through with different pairs of the models, and was frequently repeated through long spaces of the canal, as it was found that various circumstances interfered to render the resistances inconstant, such as approaching nearer to the one or the other side of the canal, passing a loaded vessel, or making a turn round a projecting part of the bank.

It was at first attempted to conduct the experiments by towing the models astern; but it was immediately found that the ripple of the wake of the steamer disturbed the uniformity of the resistance of the models. Various modifications were then tried with more satisfactory results, and finally, the arrangement was made as follows: a spar, like a bowsprit, of about twenty feet in length, was run out a little above the level of the water from the bow of the steamer, the hasp of the yoke being attached by a link to the point of this spar, the

models were in this way kept ahead of the steamer in smooth water, and were altogether undisturbed by any ripple or wave.

The accompanying tables contain the results of these trials, from which the important inference may be drawn, that there is no form which will present a minimum resistance in all circumstances; and that the form which is easiest drawn through a canal at a low velocity, does not possess the same advantages at a higher rate of speed.

By looking into the Table A, Experiment first, we see that, although the resistance of No. 1 be to that of No. 2 as 13 to 12, when the velocity is three miles per hour, yet when the speed is increased to six miles, the advantage which No. 2 had over the flatter vessel, entirely disappears.

Again, in Table B, we see that in one experiment, No. 2 carries two-ninths more weight than No. 1, with equal resistance, when the velocity is three miles per hour; but that when the rate is raised to six miles, the loads require to be made the same in both, in order to equalize the resistance.

It appears, from numerous experiments made at intermediate speeds, that this change in the relative resistance is progressive; there is reason, therefore, to conclude, that if circumstances had admitted of carrying on the experiments at a higher velocity than six miles per hour, the flatter formed vessel would have attained a superiority over the sharper ones: this conclusion is corroborated by the fact, that the swiftest going steam vessels which have been built in this country, are those which are nearly flat in the floor for a great proportion of their whole length.

The first practical inference which may be drawn from these experiments is, that all vessels which are intended to be tracked, or impelled by machinery, through canals at low velocities, should be built as sharp in their bottoms as circumstances will admit of, although this must necessarily increase their draught of water; the second inference is, that whenever vessels are intended to move in canals with a higher rate of speed than six miles per hour, the general form of the bottom should be nearly flat.

TABLE A.

Experiments with Equal Loads.

Models tried.	United Weights of Vessel and Load.	Divisions in the arms of Yoke when at 3 Miles per hour.	Difference.	Divisions in the arms of Yoke when at 6 Miles per hour.	Difference.
Flat Vessel and Coaster, Nos. 1 and 2	192 each	(No. 1) 48 (No. 2) 52	4 div. or 1-12	(No. 1) 50 (No. 2) 50	None.
ditto	256 do.	46 54	8 div. or 1-6	50 50	ditto.
ditto	320 do.	47 53	6 div. or 1-8	49½ 50½	2-100 parts.
ditto	392 do.	45 55	10 div. or* 1-5	49 51	2 div. or 1-24.
Flat Vessel and Schooner, Nos. 1 and 3	192 do.	(No. 1) 45 (No. 3) 55	10 div. or* 1-5	(No. 1) 50 (No. 3) 50	— —
ditto	256 do.	43 57	14 div. or 1-3	50 50	— —
ditto	320 do.	44 56	12 div. or 1-4	Uncertain.	
ditto	392 do.	45 55	10 div. or* 1-5	49 51	2 div. or 1-24.
Flat Vessel and Twin do., Nos. 1 and 4	256 do.	(No. 1) 50 (No. 4) 50	0 0	Uncertain.	— —
ditto	320 do.	53 47	6 div. or 1-8	ditto	— — In favour of No. 1.
ditto	392 do.	52 48	4 div. or 1-12	ditto	— — In favour of No. 1.

TABLE B.

Experiments with Equal Arms of the Yoke at three Miles per hour.

Models compared.	Depth of Immersion in Inches.	Weight of Vessels with their Loads.	Difference.	
Flat Vessel, No. 1	4.91	256 lbs.	32	No. 2 carries 1-8th more than No. 1.
Coaster, No. 2	8.5	288 —		
No. 1	6.083	320 —	72	No. 2 carries 2-9ths more than No. 1.
No. 2	10.083	392 —		
Flat Vessel, No. 1	4.17	192 —	42	No. 3 carries 2-9ths more than No. 1.
Schooner, No. 3	8.41	234 —		
No. 1	5.75	320 —	42	No. 3 carries 2-15ths more than No. 1.
No. 3	10.25	362 —		
Flat Vessel, No. 1	4.17	256 —	0	No difference at this rate of speed.
Twin do. No. 4	4	256 —		

N. B. The depth of immersion entered above, is that observed when the vessels were at rest, and which did not appear to alter when in motion.

TABLE C.

Experiments with equal Arms of the Yoke at six Miles per hour.

Models compared.	Immersion in inches.	Weight of Models when loaded	Difference.	
No. 1 Flat Vessel	4 2-12	192 lbs.		The draught of water noted in the column of immersions was that observed when the models were at rest previous to the commencement of each experiment; the actual immersion during the experiment was considerably less, especially in the flatter vessels, but there were no means of ascertaining it precisely.
No. 2 Coaster	6 4-12	192 —		
No. 1	4 11-12	256 —	—	
No. 2	8 1-12	256 —		
No. 1	4 2-12	192 —	—	
No. 3 Schr. shape	7 9-12	192 —		
No. 1	4 11-12	256 —	—	
No. 3	9 2-12	256 —		
No. 1	5 9-12	320 —	—	
No. 4 Twin Boat	5 7-12	320 —		

¶ *Account of the Depths of Mines.* *By* JOHN TAYLOR, F. R. S., *&c.*

Mr. Taylor exhibited a section, showing the depths of shafts of the deepest mines in the world, and their position in relation to the level of the sea.

The absolute depths of the principal ones were:

	Feet.
1. The shaft called Roehrobichel, at the Kitspühl mine in the Tyrol	2764
2. At the Sampson mine, at Andreasberg, in the Harz	2230

	Feet.
3. At the Valenciana mine, at Guanaxuato, Mexico	1770
4. Pearce's shaft, at the Consolidated mines, Cornwall	1464
5. At Wheal Abraham mine, Cornwall . .	1452
6. At Dolcoath mine, Cornwall . .	1410
7. At Ecton mine, Staffordshire . . .	1380
8. Woolf's shaft, at the Consolidated mines .	1350

These mines are, however, very differently situated with regard to their distance from the centre of the earth, as the last on the list, Woolf's shaft, at the Consolidated mines, has 1230 feet of its depth below the surface of the sea, while the bottom of the shaft of Valenciana, in Mexico, is near 6000 feet in absolute height above the tops of the shafts in Cornwall. The bottom of the shaft at the Sampson mine, in the Harz, is but a few fathoms under the level of the ocean; and this, and the deep mine of Kitspühl, form, therefore, intermediate links between those of Mexico and Cornwall.

Mr. Taylor stated, that taking the diameter of the earth at 8000 miles, and the greatest depth under the surface of the sea being 1230 feet, or about one-fourth of a mile, it follows that we have only penetrated to the extent of $\frac{1}{32000}$th part of the earth's diameter.

Some account was then given of the mines to which the shafts referred to belong.

Of the deepest, at Kitspühl, as it has long ceased to work, we do not know much. Villefosse, in his great work on the *Richesse Minérale de l'Europe*, states that this was a copper mine, which passed for being the deepest in Europe; and that in 1759, it was reported on, amongst other mines, by MM. Jars and Duhamel, and it was then proposed to abandon the working, the water having been already suffered to rise near 200 fathoms.

The Sampson mine, in the Harz, is one of the most celebrated in that district: it has been working since the middle of the sixteenth century, and produces silver ores of superior quality. The principal shaft is sunk about six feet deeper every year, by which ground enough is drained for a regular extraction of the ores. The mine is one of the oldest in Germany, and has always been profitable: it employs from 400 to 500 men. It is the property of shareholders, who are very numerous, the interest having been much subdivided in the course of time.

The mine of Valenciana, at Guanaxuato, was one of the most renowned in Mexico. It produced annually, about the end of the last century, 360,000 ounces of silver, worth about £600,000 sterling, and then employed 3100 persons. The shaft referred to in the section, was commenced in 1791, the mine having been long previously worked by other shafts: it had attained its present depth in 1809, when the mine was stopped by the revolution. It is octagonal, and more than thirty feet in diameter, a great part of its depth being walled with beautiful masonry, and is probably the most magnificent work of the kind. The expense of forming this shaft is estimated by Humboldt at the enormous sum of £220,000. The mine was so little troubled with water, that it was considered almost a dry one:

during the suspension of the works, it, however, gradually filled. In 1825, one of the English companies undertook to drain it, which was, after great labour and expense, accomplished; but the mine has not been sufficiently productive since to make it worth while to continue the working.

The Consolidated mines form the most extensive concern in Cornwall, embracing what were formerly several distinct mines, which, as the name indicates, were connected in one undertaking.

This was arranged in 1818, and the mines which had remained unwrought for many years, were drained by very powerful steam engines, and were put into a state of active working. The management was confided to Mr. Taylor and the late Capt. William Davey: an outlay of £73,000 was incurred, which has since been repaid with ample profit. The present produce is 20,000 tons of ore a year, yielding about 1920 tons of fine copper, being one-seventh of the whole quantity raised in Great Britain. The mines employ about 2400 persons, of whom about 1400 are miners, working under ground. The water raised to the adit level is about 2000 gallons per minute: the height to which this is lifted is more than 220 fathoms, or 1320 feet; the aggregate weight of the columns of water in the pumps being 512,000 pounds, or about 230 tons, and the whole is put in motion by eight immense steam engines, four of which are the largest ever made.

The depth of the mines has been increased 100 fathoms since the period of the drainage being completed, being at the rate of about eight fathoms a year.

There are, in the whole concern, ninety-five shafts, besides other perpendicular communications from level to level underground, called winzes. The depths of the whole added together, make up about 22,000 fathoms, or twenty-five miles; and the levels, or galleries, will make up, in horizontal distance, a length of 38,000 fathoms, or about forty-three miles.

Wheal Abraham is an old copper mine, the working of which was abandoned a few years since, the vein having ceased to be productive in depth. It was, until very lately, the deepest mine from the surface in Cornwall, but is now surpassed by the Consolidated mines.

Dolcoath mine was formerly called Bullen Garden, and a section of it as it was at that time, will be found in Dr. Pryce's work, *Mineralogia Cornubiensis*, published in 1778. It was then rather more than ninety fathoms deep, and probably one of the deepest mines at that time. It has, therefore, been sunk 140 fathoms since; but, like all the great mines, it has not been in constant work. It has now been actively prosecuted for many years, and at present stands third in the list of copper mines in Cornwall, arranging them according to the value of their produce. That of Dolcoath, however, does not amount to one half of that of the Consolidated mines.

Ecton mine is celebrated in most books on mineralogy, as one of the principal copper mines in England; and it was so at one period, though the produce is now inconsiderable. It is situated in Staffordshire, on the borders of Derbyshire, and is very curious, from being

in limestone, and having no regular vein. The ore has been found in large masses, irregularly deposited, and is generally taken to be an example of contemporaneous formation. The mine has been regularly worked for a long series of years, and is now nearly exhausted. It is the property of the Duke of Devonshire, and very large profits were given by it in the latter part of the last century, some of which, it is said, were applied by the late Duke to the erection of the beautiful Crescent at Buxton. The mine is not far distant from this place, and is in a very picturesque situation on the banks of the river Manifold.

Mr. Taylor gave some account of the extent to which steam power is at present employed in Cornwall in draining the mines which penetrate so far beneath the level of the sea, showing the influence that the great improvements, which have from time to time been made, and many of them even recently, must have upon the production of some of the most useful metals.

The number of steam engines used in pumping water from the mines in Cornwall, in December, 1832, was altogether sixty-four.

Some of these are of immense size and power: there are five in the county, of which the diameter of the cylinder is ninety inches, the pistons making a stroke of ten feet. Four of these are at the Consolidated mines, and the first constructed of this size, was planned and erected there by Mr. Woolf. The beam of such an engine weighs twenty-seven tons; the pump rods are of mast timber, sixteen inches square, connected by iron strapping plates, of enormous weight. The column of water lifted, the rods and beam, make up a weight of more than 100 tons, and this is kept in motion at the rate of from five to ten strokes per minute.

The quantity of coal consumed in drawing water in the same month, in all the mines of Cornwall, was 84,034 bushels, and the quantity of water delivered, about 19,279 gallons per minute. The weight of water actually poised by all these engines to produce this effect, amounts to about 1137 tons.

From calculations carefully made in Mexico, as to horse power employed in draining mines, and deduced from a large scale of operations, it is found that the performance is equal to 19,000 pounds raised one foot high per minute for each horse.

According to this rate, the coal consumed in Cornwall in a month, being 84,000 bushels, or 2800 per day, and taking the duty of the engines at 55,000,000 pounds lifted one foot by each bushel, which is very nearly the fact, it will be found that the sixteenth part of a bushel does as much in raising water in Cornwall, as a horse does in Mexico, (working three hours out of twenty-four,) and that thus the number of horses required to drain the mines of Cornwall would be 44,800. [*Rep. 3d Meeting Brit. Associa.*

¶ *Remarks on the Protection of Copper Sheathing upon Ships' Bottoms. By* G. G. Bompas.

It is a well known fact, that when dissimilar metals are placed in

contact in a saline, or acid, solution, such as sea-water, they have an electric action upon each other, becoming on the one part positively, and on the other negatively, electrified; the effect of which is destructive of the positive metal. This has been too little regarded in the sheathing of vessels.*

The various metals and alloys employed in the building and sheathing of a ship, almost always stand in this electric relation of positive and negative to each other; and if, as is generally the case, the copper sheathing is the positive metal, it will be destroyed with a rapidity proportionate to the degree in which the electric action is excited.

The sheathing nails in common use are prepared of metals in very various proportions, regard being chiefly had to their colour and tenacity; and an examination of several specimens has proved them to be as various in their electric relations with copper, as in their composition. They are generally negative to the copper, and, consequently, promote its corrosion. Numerous experiments have proved that the galvanic action, induced by the contact of such metals, is necessarily destructive of the positive metal; and they satisfactorily explain the irregular duration, and frequently rapid destruction, of the copper sheathing, which is often erroneously ascribed solely to impurity in the copper. If the sheathing of vessels returned from a voyage be examined, the hollows made by the heads of the nails will generally be found filled with crystals of the salts of copper, and the copper itself is often completely corroded through. In an experiment, where copper obtained from H. M.'s dock-yard was employed, and to avoid all error, each sheet was divided in half, one-half being nailed to a board with pure copper nails, and the other with different samples of the nails in actual use at different dock-yards; after ten weeks' immersion in the sea at Portsmouth harbour, one half-sheet had lost two hundred and ninety-three grains more than its fellow, a second had lost thirty-two grains more than its fellow, and a third had lost twenty grains more than its fellow half-sheet: but one with nails prepared on the principles recommended in this paper, had lost thirty-four grains *less* than its fellow half-sheet. It is fair to presume that, if sheathing nails similar to the samples had been used with the same copper on a ship, the duration of the sheathing would have been in somewhat the same proportion.

Copper possesses great advantages over the various alloys introduced for sheathing, from its flexibility and toughness, by which it

* At this very time, an experiment is making in France, by sheathing one-half of a ship's bottom with *cuivre bronzé*, a metal negative to copper, and the other half with copper, the metals being in contact. It is easy to foresee that the positive metal, the copper, will lose more by corrosion than the negative metal, and thus give an apparent, but deceptive, advantage to the *cuivre bronzé*. In one such an experiment already tried, the results of which have been published, the copper had, in fact, sustained more than what would be its *average* loss, when not connected with the *cuivre bronzé*. In all experiments on new metallic sheathings, there should be no *metallic* communication between the metal to be tried, and any other.

can be applied with facility, and yields to the strain of the vessel, while, by the slow solution of its surface, it very considerably diminishes the foulness from attachment of marine vegetables and animals. The chief objections to it are, its expense—the liability to corrosion, and consequent irregularity and uncertainty of its duration—and its being too soft to be used for nails, without an admixture of such other metals as generally render them negative to, and destructive of, the copper. But it is equally an objection to the other metals and alloys, that they cannot at the same time be sufficiently soft for sheathing, and yet hard enough to drive as nails. These disadvantages may, however, be almost entirely obviated by the plan now proposed.

First, by the use of sheathing nails that shall be compounded of such metals, in such proportions, as are known not to exercise any destructive agency on the sheathing, but, on the contrary, have a tendency to preserve it.

Secondly, by attaching to the sheathing a metal positive to it, which, while itself in the process of being destroyed, shall preserve the sheathing from corrosion. For it is evident that if, when several metals are placed in communication with each other, the most positive will be destroyed, and the others preserved, the application to the sheathing of a more positive metal, or compound, will thus be a protection to it. It is also obvious that the positive metal may easily be so applied, as that its destruction shall in no degree impair the strength of the vessel, or render necessary any general or expensive repairs.

Upon this principle, (the correctness of which he fully established,) Sir Humphry Davy applied masses of zinc, or of iron, of different proportionate surfaces, to the copper to be protected. The result was, that a very strong electric action was excited, and the corrosion and waste of the copper almost entirely prevented. But he found the electric energy so intense, if the protecting metal was in a large proportion, that the copper, by the decomposition of the sea-water, very speedily became covered with an earthy accretion, to which animals and plants adhered; and the sheathing became so foul as materially to impede the ship's progress. On the other hand, if a small proportion of the protecting metal were employed, it was destroyed so rapidly, that the duration of the protection was too short to be of any value. These difficulties induced him to abandon his experiments.

The difficulties which frustrated the attempts of that eminent philosopher, have been completely removed by the employment of a compound metal, which differs much less from the copper in its electric relation, than either iron or zinc. By the use of such a compound, in which the proportions of metals may be varied as required, a larger protecting mass may be employed, a more diffused and uniform electric action produced over the whole surface of the sheathing, and just that protection afforded which shall preserve it from corrosion, without causing foulness.

The protecting metal should be attached upon the sheathing in a

longitudinal belt, or band, a few inches wide, according to the size of the vessel, from stem to stern, about the light water line; and in large vessels, an additional band should be attached to the keel. Being in the direction of the passage of the vessel through the water, it will not impede her sailing; if destroyed, it will not injure the ship; and, when necessary, it can be easily removed, and renewed, without disturbing the sheathing.

After repeated and most satisfactory experiments at Portsmouth, under the inspection of the officers of H. M.'s dock-yard, the Lords Commissioners of the Admiralty were pleased to direct that the sheathing of H. M.'s schooner Fair Rosamond should be protected on this plan, preparatory to her sailing for the coast of Africa, where she is now stationed. She was commissioned in May, 1833, and sailed first to Oporto, and afterwards to Africa. No official report has yet been received; but in November, 1833, her copper is stated on undoubted authority, to have been clean and bright, and by subsequent accounts, it is proved to have continued so, up to the end of March, 1834.

On the whole, it has been proved that, by the adoption of the sheathing nails and protectors, the duration of the copper will be very much extended, and rendered comparatively certain; that such instances of its rapid destruction, as now so frequently occur, will be entirely prevented; and that, so far from the protectors being the cause of foulness, the sheathing will be preserved much more clean and bright than under ordinary circumstances.

Iron, and other metals, or alloys, exposed to sea-water, or acids, whether as iron cables, sheathing, or any other form, may be preserved from rust, or corrosion, on the same principle.

[*Lond. Journ.*

¶ *Detection of Adulterations in Flour.*

M. Dubuc, senior, of Rouen, has applied himself with success to the detection of farinaceous mixtures in wheaten flour. The principal substances with which flour is adulterated, are potato starch, a fecula; beans, barley, chalk, plaster of Paris, &c. An extract from his memoir is published in the last Bulletin of the Society of Encouragement, from which the following is taken.

There are two methods of detecting adulterated flour—mechanical and chemical. In France, the adulteration is principally with potato starch, as it renders the bread whiter and heavier. If there be more than ten per cent. of potato starch, it may be detected by the naked eye, or with the aid of a magnifying glass; the fecula is whiter, the particles are angular, and reflect the rays of light, like minute crystals. To render the discovery more easy, M. Dubuc dries the suspected flour in a sand bath, at 100° to 110° of Fahrenheit; and then, with a good magnifying glass, so small an adulteration as five per cent. may easily be detected.

But if the miller has been cunning enough to grind the potato starch with the wheat, other means of detection must be had recourse to.

The first is, from the great difference between the specific gravities of wheat flour, and potato starch.

The second is, that flour contains a certain per centage of *gluten*, and the starch does not contain an atom of gluten.

First Method.—A vessel that will contain one pound of flour, gently pressed down, will contain a pound and a half of *fecula;* from these data, the relative proportions of flour and fecula, in any parcel of flour, may be easily ascertained, very near the truth.

Second Method.—The best flour contains about twenty per cent. of gluten, and, as we have stated, the starch not an atom.

Experiment.—Take five ounces of pure wheat flour, and two ounces and a half of warm water; mix and work it well for about ten minutes; the paste will be firm and elastic. Let a little warm water fall continually upon it, while you continue to knead it; by this means, all the starch and saccharine mucilage will be extracted. The operation is finished when the water flowing from it ceases to be white; what remains is gluten, the weight of which will be about one ounce. If the flour be adulterated, the paste will be more liquid, less cohesive, and less elastic; and an intelligent baker will soon be able to discover to what extent the flour has been adulterated, from the appearance of the paste, &c.

Such are the mechanical means that may be employed with success.

Employment of Chemical Agents to discover Frauds in Flour.—It will be well to bear in mind that wheat flour is an animalised azotic matter, (*matière animalisé azoteé*,) and that, on the contrary, fecula, or the starch extracted, pure from cereals, is entirely of a vegetable nature; from this difference, results the varied effects of the re-agents employed.

The three chemical tests which have been found best for general use, are nitric and muriatic acid, and the liquid nitrate of mercury, (*deuto nitrate.*) Their chemical effects on flour and fecula are as follows:

1st. Nitric acid has the property of colouring wheat flour of a fine orange yellow, whereas it neither affects the colour of fecula nor starch.

2d. Pure muriatic acid colours good wheat flour of a deep violet, but dissolves fecula and starch, and forms with it a light, colourless, viscous fluid, decomposable by alkalies.

Experiments with Nitric Acid of forty.—Take 100 grains of pure wheat flour, pour on it 100 grains of nitric acid, (aquafortis,) in a small earthern or china cup, stirring it with a glass tube, it will heat a little, and in a few hours it will change colour, from yellow to a fine orange colour.

Take 100 grains of fecula, and pour on it 100 grains of nitric acid; heat it in every respect the same as above, but no caloric will be evolved, and the mixture will not change colour.

Take of flour 80 grains, and of fecula 20 grains, and of acid 100 grains; mix well; the colour will now be much paler, and of a light citron colour. Take 50 grains of flour, and 50 grains of fecula, and 100 grains of acid; mix well: the colour is now much paler than before, so that, with a little practice, the quantity of fecula may be detected by the greater or less intensity of colours.

Experiments with Muriatic Acid of twenty-one degrees of strength.—Take of wheat flour and acid, each 100 grains; mix well; the colour will become at first red, then violet, and finish by becoming of a beautiful indigo colour. This operation is accelerated, if a gentle heat be applied.

Take 100 grains of fecula, and 100 grains of acid; the mixture is at first of the consistence of paste, and then becomes liquid; the fecula is dissolved, and the solution *colourless*.

On varying the proportions of flour and fecula, we shall soon be able to ascertain the quantity of fecula in a sample of suspected flour.

Experiment in the liquid Nitrate of Mercury.—Take of flour and nitrate, each 100 grains; mix well with a glass tube, or rod. The paste will at first be of a pale citron, then reddish, and in three hours will become a full red. The colour is permanent.

Take 100 grains each of fecula and nitrate; they will not combine, nor will the colour of the fecula, or starch, be acted upon.

By mixing flour and fecula in different proportions, and observing the colours, we may soon be able to detect the proportions in which flour is adulterated by fecula, or starch.

It may also be observed, that fecula absorbs less water than flour, which affords a ready means of detection.

The adulteration with bean, or pea flour, may be detected by pouring boiling water upon it, which developes the peculiar smell of these two substances.

We may add, that the adulteration with chalk, or gypsum, may be detected by pouring a diluted acid on the suspected flour, as an effervescence will take place, and carbonic acid gas be disengaged.

[*Ib.*

¶ *Remarks on Sugar Refining, and on Dr. Ure's Experiments.*

There is scarcely any branch of domestic industry which has stronger claims to the attention of our Government than the sugar refinery of this country. As a branch of our colonial trade, it is of great importance; as a manufacture continually advancing upon principles of scientific improvement, its details and operations have for some years past attracted much public attention. The insertion of the whole of Dr. Ure's experiments and long report in this journal, attest the interest which men of science attach to the process, and will be my excuse for some detailed observations upon those experiments. They were made by direction of the Board of Trade, for the purpose of correctly ascertaining the quantity of refined sugar

and extracts which could be produced from one hundred weight of raw or clayed sugar, in order to enable the Government to adjust in an equitable manner, the amount of drawback which should be allowed as an equivalent to the amount of duty paid upon the hundred weight of colonial sugar.

The refiners, as a body, have been naturally indisposed to state the maximum quantity of refined produce from the hundred weight of raw material, not because they would throw a small additional drawback into the exporter's hands, but because the maximum produce is continually varying, according to various improvements adopted by the several refiners; and because the details of the refinery as to what quantity shall be produced in the course of continued operations, from the hundred weight of raw, must necessarily depend upon the judgment each refiner entertains of the relative state of the home, including the export, market, with the raw sugar market,—which judgment must guide him as to the conversion of the great bulk of his inferior sirops into sugar that shall be just entitled to the bounty, or into Basseterre, commonly called bastard, of which little or none is exported, and into treacle, which claims no drawback. Dr. Ure has communicated so many of the arcana of the sugar refinery in his report, that I may be allowed to add the single secret upon which the whole process mainly rests as to profit or loss, the grand object of concern at the close of this very complicated manufacture. These preliminary observations are necessary to the clear apprehension of the effect and consequences induced by the various scientific improvements made of late years in the production of refined sugar. The principal of these improvements may be stated to be Dr. Howard's invention of boiling the sirops in vacuo, and the almost simultaneous use of animal charcoal; vegetable charcoal had been used for some time previous to the introduction of animal charcoal. Scientific readers need not be informed that the effect of boiling the sirops in vacuo must be the production of a larger proportionate quantity of refined extract than can be procured under the open pan process, which, by the intensity of the fire under the pan, carbonizes, to a certain extent, the sirop subjected to this operation. But men of science are not generally aware that sugar produced in the low temperature of the vacuum pan, or of bath pans, will not stand the action of sea-damp in a long voyage, in any thing like the degree that open pan refined sugar will. The exporters are fully aware of this fact. Dr. Ure found that "damage was done by slow evaporation;" page 140; and his first "loaves were not only porous, but so devoid of cohesion, that, falling into powder, they had to be worked up again."—Vide p. 140, and Table I., p. 205.

Howard's process of boiling in vacuo is, however, an important and beneficial discovery; it undoubtedly produces a larger quantity of refined sugar, of a superior quality as to whiteness and brilliancy; and the public, by means of this and other improvements, have their finer sugars cheaper. The superior advantages derived from these improvements, relate, also, to the quantities more rapidly turned into the market. But I am decidedly of opinion that a given quantity of

Howard's patent sugar does not sweeten to the extent that open pan sugar of the same or inferior complexion does; nor will it, I apprehend, give, after fermentation, an equal quantity of alcohol by distillation: which alone indicates the relative quantity of saccharine principle, or matter, contained in any given quantities of sugar, either raw or refined. Upon the subject of vacuum refining, I may just observe, that the original cost of the steam engine, and the apparatus generally, is excessive. It is highly probable, that, notwithstanding the superior quantity and quality of the produce, the invention has only benefitted those who have held and licensed out the patent—not the refiners who have used it: several of the largest vacuum refineries have failed, or have ceased their operations. Indeed, I believe, that, notwithstanding the aid of Government, and the "artifices," as Dr. Ure has it, of the refiners, sugar has been transmitted into its refined state, for a series of years, *pro bono publico*. The expenses of a refinery are so enormous and various, that it requires the greatest discrimination in the choice and purchase of the raw material, united to the most matured and sound judgment in the arrangement of the complicated details of the process, to insure the mere common interest upon the capital employed. [*Ibid.*

¶ *Simple Mode of Extracting the Wax from Honeycombs.*

Sir,—As the season is approaching in which cottagers and apiarians generally commence their operations on the product of their beehives, I think you will confer an obligation on many of your readers of that class, by disseminating amongst them the following most simple and efficient method of extracting the wax from the combs.

Get a bag made of coarse hempen cloth, such as safe cloth, or strong cheese cloth, either of which will do—its size to be determined by the quantity to be operated upon. Break up the combs so as to occupy as small a space as possible. Tie the bag close, and to its mouth and each corner attach weights of sufficient preponderance to sink the bag and its contents to the bottom of the water in the boiler, and retain it there. Regulate your fire so that the water shall boil steadily; the wax will speedily find its way to the surface, not unlike the fat in culinary processes, and may as easily be skimmed off into a milk pan, or some other vessel of sufficient diameter. If some water be taken up with it, it is of no consequence. Then provide a smooth blunt staff, and press and work the bag as it lies on the bottom of the boiler, until it will yield no more. If you then raise up the bag, and discharge its contents, you will find the residuum a mere mass of dirt, with not a particle of wax remaining. This no one will be surprised at, if they give this very simple process but a moment's consideration. Indeed, the results of this method are so very obvious, that I can scarcely flatter myself the same idea may not have occurred to others; but, as far as I am aware, it originated entirely with myself. I have practised it for at least forty years past. I have kept bees forty-seven years; and finding the dif-

ferent processes in use for extracting the wax, were most wasteful and troublesome, I at last hit upon this expedient, when every difficulty vanished in a moment, I have not failed to impart it to others, as far as my circle extends; still, I am certain it is far from being generally known.

To bear me out in this assertion, I need only observe, that I have read every treatise on bees worth notice, even down to Mr. Nutt; yet neither Mr. Nutt, nor any of the older authors, have struck out any new light to direct us through this hitherto filthy and wasteful process. It would provoke the risible muscles of your readers, were I to describe the various operose and unscientific methods (even now in use) to effect it, such as submitting the bag (drawn out of boiling water) to the action of a cheese press, or with some, (who have not that convenience) holding the bag suspended whilst an assistant compresses it with a pair of tongs, at a risk of scalding the whole party, &c. &c. On completing my first process, the wax is immediately ready for melting down into any form you like. Should any person wish to melt his brightest and clearest combs by themselves, this he may readily do, and make a second immersion with the fouler combs; but I have always done it at once, by melting down the skimmed wax, and pouring it into a pan or basin adapted to its quantity (having previously wetted its inside with cold water, to prevent adhesion,) and then covering it up warm, that it may cool gradually; after which the inferior wax (at the bottom) may be cut off, melted, and poured into any small receptacle, for the use of the family.

Yours, &c.

August 13, 1834. WILLIAM DUMMETT.

[*Lond. Mech. Mag.*

¶ *The Refractive Powers of the Atmosphere, a Frequent Source of Error in Surveying.*

INSTITUTION OF CIVIL ENGINEERS, APRIL 15.—"A conversation was held on the refractive quality of the atmosphere as affecting the taking of levels—an extract from the Memoir of the late Captain Joseph Huddart, relating to the subject, having been previously read. Captain Huddart had frequently remarked that low lands, and the extremities of head lands, forming an acute angle with the horizon when viewed at a distance, appeared elevated above the horizon, with an open space between the land and the sea. These appearances he considered to arise from, and be in proportion to, the evaporation going on at the time, and felt convinced they were caused by evaporation; and that, instead of the refraction of the atmosphere increasing to the surface of the sea, it must decrease towards it from some elevated space; and that the principal cause which prevents the uniformity of density and refraction being continued, by the general law, down to the surface, is evaporation. A member concluded, from the above statements, that the maximum of refraction was at the point most elevated from the surface to which evaporation extends, and

consequently that a person should be guarded in taking levels when elevated from the surface of a marsh, or body of water, during the process of evaporation. A member had frequently observed objects across the Thames come into view on the rise of the tide, which, at low water, were hidden by the intervening land; this he attributed entirely to refraction, and considered that levels across a body of water should be taken as near the surface as possible. It was observed that this phenomenon was probably caused by the greater width of refractive medium; also, that long sights were to be avoided in taking levels after heavy rains; and that in levelling across a stream, more accuracy would be attained by assuming the height of water equal at both sides, than by taking a sight with a spirit level." *Athenæum.* [*Ibid.*

¶ *Straw Paper.*

"The great price which rags acquired some few years since, in consequence of the great increase of printing and the paper trade, induced many ingenious men to turn their attention to discover other materials for making paper. A very large manufactory was established some years ago, in London, for making straw paper at Millbank, by the river side; but the scheme proved abortive, and the premises were lately disposed of.

"In 1802, Mr. Matthias Koop invented the following method of making straw paper, for which he obtained a patent. For each pound of straw, or hay, a pound, or a pound and a half, of quicklime is to be dissolved in about a gallon or six quarts of river water.

"The hay, or straw, is to be cut into portions about two inches in length, then boiled in a considerable quantity of water, viz: about two gallons to a pound of materials, for three-quarters of an hour. It is then to be macerated in the solution of lime and water, for five, six, seven, or more days, taking care to agitate the mass by frequently stirring and turning it over. At the end of this time, the lime water is to be drawn off, and the materials to be washed very clean, then boiled in a large portion of clean river water. This part of the operation is to be repeated, and, for the sake of improving the colour of the paper, one pound of dissolved crystal of soda, or potash, may be used to every thirty-six pounds of straw, or hay.

"When the materials are pressed out of the water, the manufacture of them into paper, may be proceeded with by the usual and well known processes. In some cases, the patentee has thought it advisable to suffer the materials to ferment and heat before they were reduced to a pulp, as was formerly the case with the rags for paper making. This, however, will always depend upon the warmth of the Season.

"When thistles are used, they are to be cut down when the bloom begins to fall, to be dried and reduced into lengths of two inches; and then the same process to be made use of, as has been already described with regard to the straw and hay."—*Hansard's Typog.* [*Ibid.*

¶ *The Russian Platina Mines.*

A report has recently appeared, in the Berlin State Gazette, upon the production of platina, and the present state of the mines of that metal in the Russian empire. During ten years, from midsummer, 1824, to January, 1834, the quantity of platina ore extracted from the mines in the Ural mountains, amounted to 230 quintals, which yielded upwards of two-thirds of pure metal. Of this, about 153 quintals were coined, amounting to a sum of 8,186,620 roubles. About 160 pounds were employed in the manufacture of vessels for the separation of gold from silver, and for other purposes. Estimating the amount coined as below one million sterling, and this product of the mines being spread over a period of ten years, it would appear that beyond the cost of the establishments, but little clear revenue has been derived from the mines. But as they are the exclusive property of the crown, and worked by serfs, whose maintenance may be estimated at the minimum of the cost of human support—and moreover, as the quantity of ore has progressively increased with the progress of the mining operations, it is by no means to be supposed that the Ural mines may not add, in a very considerable degree, to the wealth of the Russian empire. Platina being a metal of great unimpressibility, much difficulty was experienced in first converting it into coin; but at length a die of the most ingenious description was constructed for the purpose, by a French mechanist, who is said to have received a very large reward. The coin has hitherto preserved an exact mean between the value of gold and silver; but how its future value may be changed by the increased supply of the ore, and its comparative intrinsic utility for other purposes than money, is yet to be determined. The coin is a handsome one, and specimens, we believe, may be seen at the British Museum.

[*Ibid.*

¶ *Manual Labour and Mental Cultivation.*

"My conviction—not lightly taken up, but the result of long and earnest thought—is, that daily occupation with manual labour is in no way incompatible with the highest mental cultivation and refinement; that, so far from the exercise of mechanical employment daily, for a moderate time, being detrimental to the mental powers, it has, on the contrary, a decided tendency to strengthen them; and that, if those who at present serve the public in the capacity of writers, were to employ several hours a day in mechanical labour, their bodily health would be improved, and their writings would take a character of vigour startling even to themselves. They would find the workshop a more healthy atmosphere than the drawing room. There is no reason, save ignorance, why any thing like degradation should attach to the character of the working mechanics. There is no reason, save ignorance, why they should not have dwellings as good as

their employers, as to all the purposes of comfort. There is no reason, save ignorance, why they should not have refreshing baths after their daily toil, and abundant change of comely garments conducive to health. There is no reason, save ignorance, why they should not have abundance of good and well-prepared food for the body, and access to books of all kinds for the proper culture of the mind. There is no reason, save ignorance, why they should not have access to theatres, and operas, and lectures of all kinds, and picture and sculpture galleries, and museums, far more imposing than any thing the world has yet beheld. There is no reason, save ignorance, why the great body of the working people should not possess, in addition to all that is necessary for the comfortable maintenance of the body, all the pleasures of mental refinement, which are now only within the grasp of the very rich. There is no reason, save ignorance, why the ruling power of the state should not be in their own hands, and all else, save only the excitements of ostentation, and expensive sensuality."

[*Tait's Mag.*

¶ *Pin Heading.*

The process of pin-heading, three establishments for which I visited, is carried on in the following way: A large room is filled with small tables, at each of which sit four children, about thirty or forty together in a room, and certainly of ages lower than I should suppose it possible could be employed in any other gainful occupation. The majority of those I saw did not appear to be above seven or eight; and, in fact, the scene, as far as regards the ages of the children, reminded me more of an infant school, than any thing else I had ever witnessed. A sort of frame is fixed before each child, on which is suspended a heavy weight, which is kept in perpetual motion by the child pressing its foot on a treadle beneath the table; and the continual thumping noise of which, close to the infant's ear, seems well calculated to produce the ear-ache, complained of by several witnesses. Each child is in a position continually bent in the form of the letter C, its head being about eight inches from the table, and both its hands engaged in taking up the shanks, and putting heads on them, which heads are then tightened by blows from the weight suspended before it. On the whole, the employment of pin-heading seemed to me the most irksome and monotonous, without exception, I had ever witnessed; and knowing the cruelties that are sometimes practised at it, to keep their infants at work, I was not surprised at being told by a manufacturer, that he had been once engaged in the trade, but had left it, owing to the disgust he felt at this part of the business.—*Mr. Tuffnell's Report, Factory Commission.*

[*Lond. Mech. Mag.*

¶ *Remarks on Flame. By Mr.* J. Murray.

The non-transit of flame through orifices formed in *non-radiating* and *non-conducting* materials, I was the first to establish, in dis-

tinct contradiction to the universally received opinion, and none has ever advanced, so far, a fairer claim. The recent experiments of Dr. C. Williams have also fully corroborated my other views respecting *flame*, namely, that though it cannot be denied that there are flames which possess intense temperatures, there are other specific flames which exhibit comparatively low grades of temperature. Thus, Dr. Williams has shown that there are flames into which the finger may be introduced without suffering; therefore, the assumption that "flame, *in all cases*, is inflammable or gaseous matter, heated *above whiteness*," "and that to a degree *infinitely* above the *white heat of solid bodies*," is an error of the most palpable description. [*Ib.*

List of American Patents which issued in February, 1835.

		Feb.
58.	*Straw cutter.*—Stephen Ustick, city of Philadelphia,	5
59.	*Sawing staves.*—Hart Pepper, Southwick, Mass.	5
60.	*Fur cutting machine.*—Curtis M. Sampson, city of New York,	5
61.	*Thrashing machine.*—Joseph Ross, Boundbrook, New Jersey,	6
62.	*Clover hulling.* " " "	6
63.	*Ships' windlass.*—Seth Adams, Boston, Mass.	6
64.	*Cheese press.*—Rufus Porter, Belerica, Mass.	6
65.	*Washing machine,*—Amos C. Hanniford, Northfield, New Hampshire,	6
66.	*Auger, or bit.*—Ezra L'Hommedieu, Saybrook, Conn.	11
67.	*Theodolite.*—James Eames, Newry, Maine,	11
68.	*Horse rake.*—Noah Briggs, New Hartford, New York,	11
69.	*Corn sheller.*—J. H. Taylor and A. J. Cowles, Westfield, N. Y.	11
70.	*Plough.*—David Ghormley, Wayne, Ohio,	13
71.	*Hogs, scalding.*—Thomas J. Godman, city of Baltimore,	13
72.	*Furnace bake-oven.*—Charles E. Russell, city of Philadelphia,	13
73.	*Plough.*—Nathan Robinson, Sacketts' Harbour, New York,	13
74.	*Brad cutter*, revolving.—A. B. Woods, and E. Talbot, Jr., Windsor, Conn.	13
75.	*Cotton planter.*—Michael Bean, Buffaloe, North Carolina,	13
76.	*Corn sheller.*—E. Reed, and A. L. Norcross, Hallowell, Maine,	13
77.	*Forge back.*—Isaac Sawyer, Hallowell, Maine,	13
78.	*Brick striker.*—Peleg Sweet, Ashtabula, Ohio,	20
79.	*Paper making.*—John Ames, Springfield, Mass.	20
80.	*Cement for reservoirs.*—John C. Johnston, Cattskill, New York,	20
81.	*Rotary steam engine.*—George M. Alsop, city of Philadelphia,	20
82.	*Water proof roofs.*—Lyman Garfield, Troy, New York,	20
83.	*Ventilation for ships.*—James Barron, city of Philadelphia,	20
84.	*Percussion lock.*—Robert Beale, city of Washington,	20
85.	*Mill bush, ring, and bale.*—Warren P. Wing, Greenwich, Mass.	20
86.	*Plough.*—Benjamin Johnston, Hickory Grove, Ill.	20
87.	*Percussion lock.*—Thomas Daplyn, Dover, Delaware,	20
88.	*Scoop shovel.*—J. and W. Smith, Williamstown, Mass.	25
89.	*Chairs, &c. on rail roads.*—J. M. Palisse, and S. S. Durfee, Hudson, New York,	25
90.	*Cooking stove.*—Paul Wing, Grafton, Mass.	25
91.	*Cutting meat.*—John Morris, Derby, Conn.	25
92.	*Propelling wheel.*—Nehemiah Dodge, city of New York,	25
93.	*Mortising machine.*—Grove Bradley, Auburn, New York,	25
94.	*Potato washing machine.*—William Ellis, Waterville, Maine,	25
95.	*Branding irons.*—E. Barns, G. Hills, and J. B. Hawkins, Ashtabula, Ohio,	25

CELESTIAL PHENOMENA, FOR MAY, 1835.

Calculated by S. C. Walker.

Day.	H'r.	Min.				
1	7	5	Im.	B Tauri,	,5,	N. 88° V. 146°
1	8	14	Em.			268° 324°
2	7	41	Im.	ι Geminorum,	,3,	65° 123°
2	8	52	Em.			289° 345°
3	10	34	Im.	k Geminorum,	,4,	110° 163°
3	11	22	Em.			222° 273°
6	8	16	Im.	42 Leonis,	,6,	145° 173°
6	8	21	Em.			153° 181°
1	15	8	Im.	ν' Libræ,	,6,	117° 156°
11	15	52	Em.			203° 247°

Meteorological Observations for January, 1835.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches.	Inches.			Inches.	
☾	1	24°	29°	29.90	30.05	W.	Moderate.		Clear day.
	2	32	41	.80	29.90	W.	do.		Cloudy—lightly cloudy.
	3	14	17	30.10	30.20	N.W.	Calm.		Clear day.
	4	2	10	29.84	29.84	W.	do.		Clear day.
	5	−5	16	30.23	30.13	W. N.	Brisk.		Clear day.
	6	19	19	.04	.12	N.E.	Moderate.		Clear day.
	7	0	32	.20	.30	N.	do.		Clear day.
	8	1	14	.20	.20	N.	do.		Clear day.
	9	0	30	.20	.24	N. SW.	Calm.		Clear day.
	10	6	36	.20	.20	N. N.	Moderate.		Clear day.
	11	20	35	.15	.14	W. SE.	do.		Clear day.
	12	17	35	.06	.03	W.	Calm.		Clear day.
	13	36	44	29.93	29.87	NW. SSW	Moderate.		Lightly cloudy—hazy.
	14	36	38	.34	.51	W. SE.	Calm.		Rainy day.
	15	33	40	.20	.24	W.	do.	0.75	Lightly cloudy—hazy—rain in n't.
☉	16	38	46	.44	.60	W.	do.	0.85	Cloudy—flying clouds.
	17	33	37	.05	30.05	W. SE.	Brisk.		Clear—lightly cloudy.
	18	29	34	30.00	29.95	W.	do.		Cloudy—clear.
	19	21	36	.06	.07	N. NW.	Moderate.		Clear—cloudy.
	20	30	43	29.80	.85	W.	do.		Cloudy—clear
	21	33	44	.85	.65	W.	do.		Cloudy; lightly cloudy; rain in n't.
	22	35	41	.42	.60	E. Sw.	Brisk.	0.16	
	23	37	47	.70	.85	W.	do.		Clear day.
	24	31	36	30.30	30.30	W.	Moderate.		Lightly cloudy—cloudy.
	25	33	42	29.93	29.93	SE.	do.	0.10	Cloudy—drizzle—rain.
	26	43	46	.15	.65	W. SSW.	do.		Cloudy—foggy—rain with light'g.
☽	27	39	50	29.65	.75	W.	do.	0 62	Clear—lightly cloudy—rain in n't.
	28	32	49	.70	.60	W.	Brisk.	0 11	Cloudy—flying clouds.
	29	43	43	30.10	30.15	W. SSE.	Moderate.		Clear—rain in night.
	30	46	46	29.86	29.70	E.	do.	0.60	Rain: foggy: rain in night, thunder
⊗	31	40	43	.85	.35	W.	Brisk.	0 62	Cloudy—flying cl'ds. & lightning
	Mean	24.87	34.77	29.90	29.91			3.21	

	Thermometer.	Barometer.
Maximum height during the month,	59. on 27th,	30.30 on 24th.
Minimum do.	5. on 5th.	29.25 on 31st.
Mean do.	29.82	29.90